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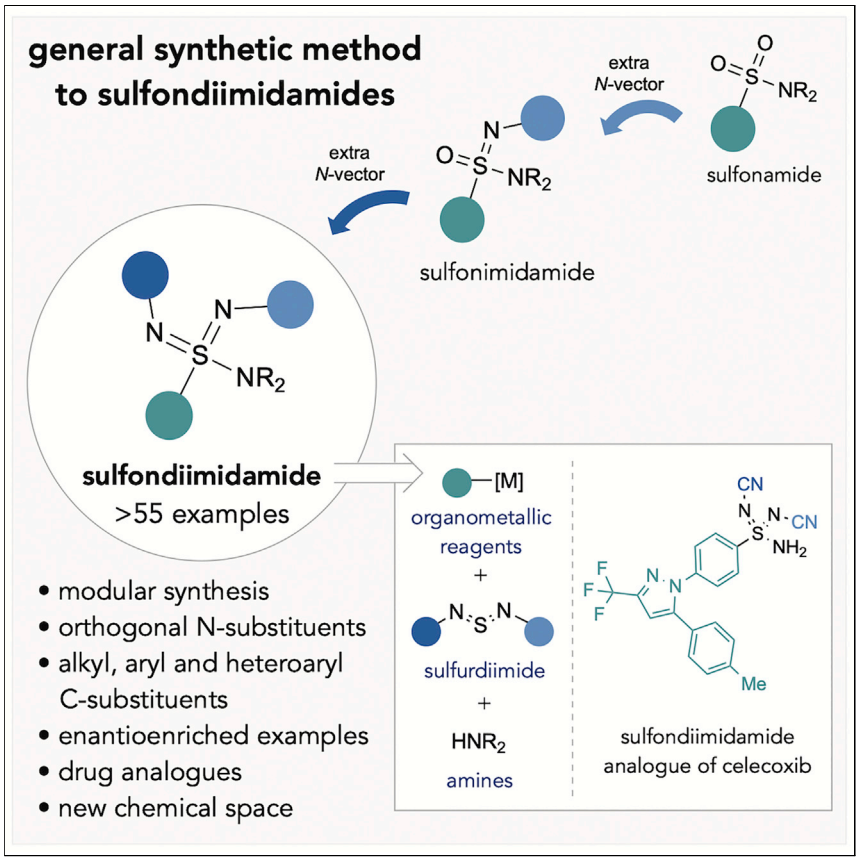
Sulfondiimidamides as new functional groups for synthetic and medicinal chemistry



The double aza variants of sulfonamides—sulfondiimidamides—are elusive functional groups with extremely limited precedent. We establish that these new groups are stable, that they can be prepared efficiently, are amenable to modification, and that S-chiral versions are possible. Exploiting an unsymmetrical sulfurdiimide reagent unlocks their three-component assembly, using organometallic reagents and amines as the building blocks. Broad variation at all three nitrogen atoms and at the carbon substituent is possible. We also synthesize a sulfondiimidamide analog of the COX-2 inhibitor celecoxib.

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Highlights

Efficient three-component assembly of sulfondiimidamides; new analogs of sulfonamides

Use of unsymmetrical sulfurdiimide reagents is key to success of the synthesis

Broad variation at all three nitrogen atoms and the carbon substituent

Preparation of enantiomerically enriched, chiral at sulfur, examples

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Sulfondiimidamides as new functional groups for synthetic and medicinal chemistry

Ze-Xin Zhang[1] and Michael C. Willis[1,2,*]

SUMMARY

Due to their three-dimensional structure, chemical and metabolic stability, polarity, and hydrogen-bonding ability, sulfonamides occupy a privileged position among the functional groups used to design bioactive molecules. The mono aza variants, sulfonimidamides, a functional group known since the 1930s, possess an extra nitrogen atom, which delivers an additional point of diversity and introduces chirality at sulfur. However, the double aza analogs, sulfondiimidamides, are elusive molecules with severely limited accessibility. We show that sulfondiimidamides are viable molecules and that by using an unsymmetrical sulfurdiimide as a linchpin, in combination with organometallic reagents and amines, that their three-component assembly is possible. Variation of the substrates, and the controlled manipulation of nitrogen functionality, allows a broad range of substituents to be introduced at all three nitrogen atoms and at carbon.

INTRODUCTION

The discovery of the first "sulfa drug," Prontosil,[1] in the 1930s predated the first isolation of a naturally occurring sulfonamide by some 50+ years.[2,3] Given the diverse applications enjoyed by sulfonamides, ranging from medicines[4] to agrochemicals[5] to materials,[6] these functional groups provide an excellent example of how a designed functional group,[7] as opposed to one commonly found in nature, can have broad impacts on society.[8] Sulfonamides continue to play an important role in the design of new medicines and feature in 10%–15% of annual Food and Drug Administration (FDA) approvals.[9] Elexacaftor, a component of Trikafta, approved by the FDA in 2019 for the treatment of cystic fibrosis, is a pertinent recent example (Figure 1A).[10] Replacing one of the oxygen atoms of a sulfonamide with a nitrogen atom produces a sulfonimidamide (Figure 1B) and from a discovery chemistry perspective defines a new region of chemical space.[11,12] This is beginning to be exploited,[13] with bioactive sulfonimidamides being used in a diverse range of applications.[14–20] Sulfonimidamides are a designed functional group,[21] and are unknown in nature.[22] One of the key attributes of sulfonimidamides comes from variation of the imidic N-substituent (R^1 in Figure 1B), as this provides opportunities to modulate the physiochemical properties of these molecules[13] as well as delivering a further vector to be explored in the study of structure-activity relationships (SARs).[12] The introduction of basic nitrogen atoms to increase biological potency is a popular tactic in medicinal chemistry and has been applied in varied settings.[23] However, the further substitution of oxygen for nitrogen in the context of sulfonamides and sulfonimidamides, to generate the double aza-analogs called sulfondiimidamides, is unknown in medicinal chemistry.[24,25] In fact, sulfondiimidamides are essentially unexplored functional groups;[26,27] they lack viable synthetic routes,[28] and there are scant data concerning their stability and further manipulation.[29] Given the central

The bigger picture

A functional group is an arrangement of atoms that defines the key topology and reactivity of a molecule. The ability to modify these two parameters in useful and predictive ways is the foundation of synthetic organic chemistry and accounts for the wide-ranging applications enjoyed by organic molecules. For example, medicinal chemists often tune the substituents attached to specific functional groups as they explore chemical space, searching for biologically active molecules.

Sulfonamides have a long history in medicinal chemistry, with the first biologically important examples, the "sulfa drugs," being described in the 1930s. Here, we report a new functional group, the sulfondiimidamides, which are the double aza analogs of sulfonamides. We show that these new molecules are stable, that they can be efficiently prepared, and that precise manipulation and functionalization of these groups is possible. Sulfondiimidamides provide an exciting new scaffold for exploring chemical space.

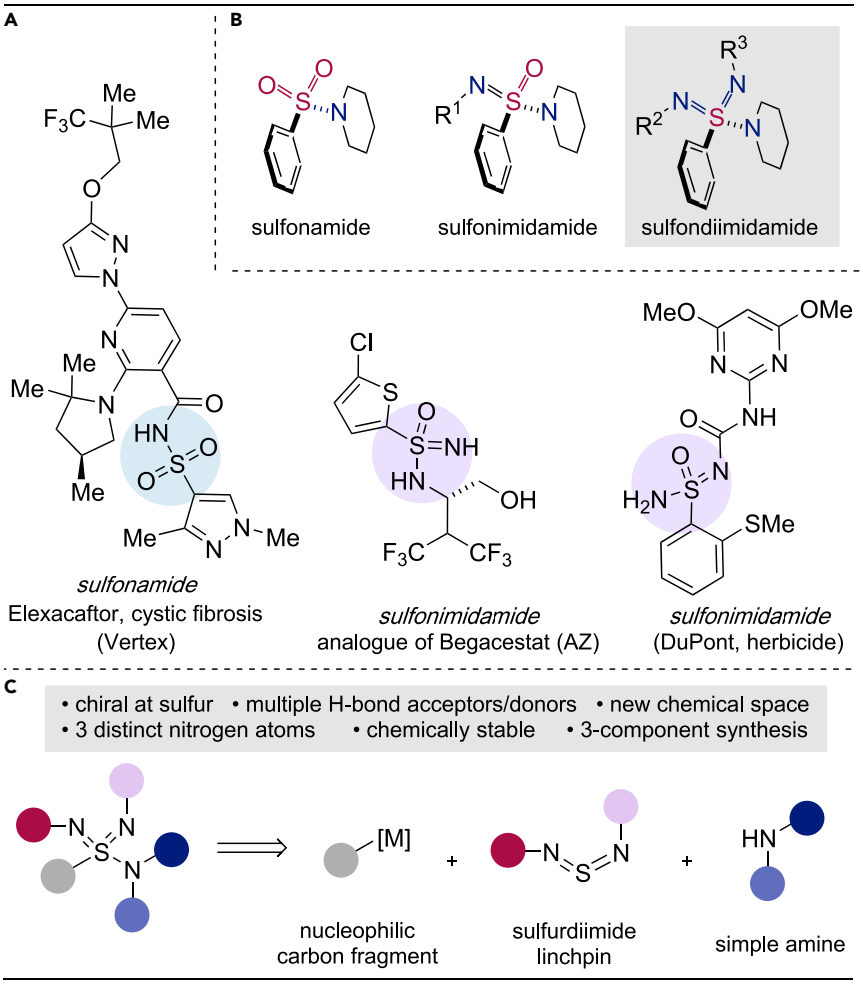

Figure 1. Examples of S(VI) derivatives and this work

(A) Examples of biologically active sulfonamides and sulfonimidamides.

(B) Sulfonamides and their mono- and di-aza derivatives.

(C) This work: a three-component synthesis of sulfondiimidamides.

role of sulfonamides in medicinal chemistry and the recent surge of interest in sulfonimidamides, this absence is striking. This newly designed functional group—a sulfondiimidamide—offers a potent mix of additional structural diversity, tuneable basicity, and unexplored chemical space, with the corresponding patent freedoms that this brings.

The small number of sulfondiimidamides reported are not amenable to discovery chemistry, featuring either symmetrical di-alkyl or di-triflyl N-substituents.[26,27,30] In addition, the syntheses offer little scope for structural variation and employ unattractive, hazardous reagents. We envisioned a divergent synthesis, in which a central sulfurdiimide linchpin is combined with a carbon fragment and an amine fragment in a three-component assembly (Figure 1C). Organometallic reagents, such as Grignard reagents and organolithiums, would form the carbon fragment. This type of approach would exploit the vast array of commercial amines and aryl, heteroaryl, and alkyl halides (as the organometallics precursors), and would allow access to a diverse range of sulfondiimidamides. The proposed synthesis would require an oxidative adjustment to allow the union of two nucleophilic fragments to the central linchpin reagent.

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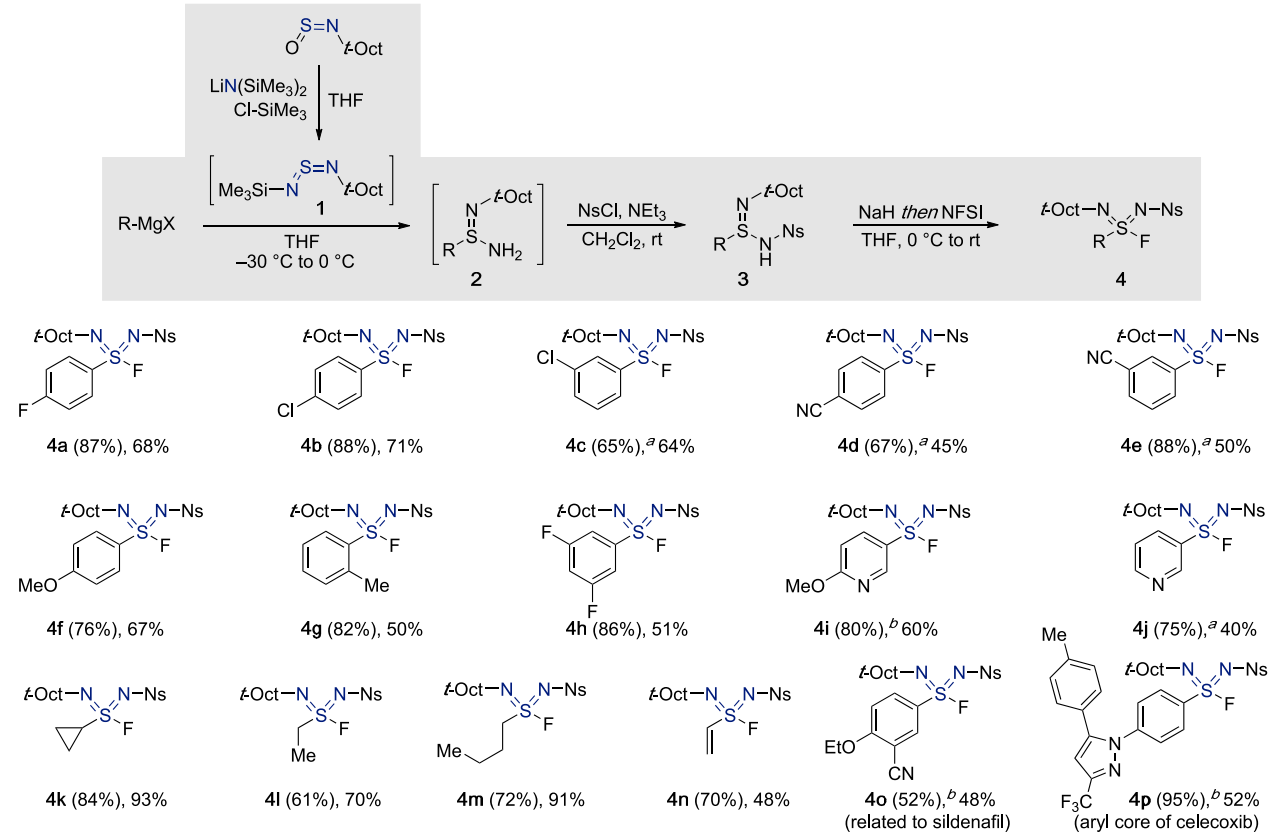

Figure 2. The synthesis of sulfondiimidoyl fluorides 4, using sulfurdiimide reagent 1, and proceeding via sulfinamidines 3

The yield in parenthesis is for the relevant sulfinamidine (**3**), and the final yield is for the fluoride **4**. Both are isolated yields. Ns, 4-NO_2-C_6H_4-SO_2-. [a]"Turbo Grignard" reagent (R-MgCl.LiCl) employed. [b]Organolithium reagent employed.

RESULTS AND DISCUSSION

Synthesis of sulfondiimidoyl fluorides

To achieve the structural diversity that we targeted and allow for further synthetic manipulation, we required an unsymmetrical sulfurdiimide reagent in which the two N-substituents could be selectively modified. Accordingly, we designed sulfurdiimide reagent **1**, featuring N–$SiMe_3$ and N-*t*-octyl substituents for initial evaluation (Figure 2). Reagent **1** could be prepared from the corresponding *t*-octyl sulfinylamine, recently reported by our laboratory for the synthesis of sulfondiimines,[31] by adapting a procedure from Zibarev and co-workers.[32] Although diimide **1** could be isolated, it was more practical to combine it directly with an organometallic reagent to deliver N-*t*-octyl sulfinamidines **2**. Conveniently, the N–$SiMe_3$ substituent was removed during work-up. Installation of a 4-nosyl (Ns) substituent on nitrogen then yielded the first intermediates that were routinely isolated, the N–Ns N-*t*-octyl sulfinamidines **3**. The conversion of sulfinamidines **3** into sulfondiimidoyl fluorides **4** was achieved efficiently by first deprotonating with NaH, followed by the addition of NFSI as a F^+ source, which affected oxidative fluorination. Attempts to achieve this transformation using weaker bases such as K_2CO_3, NEt_3, or no base at all, were unsuccessful, with starting material being recovered (see supplemental information; Table S1, for details). This route allowed a broad range of Grignard and organolithium reagents to be used, but not organozinc reagents, which were found to be insufficiently reactive. Electronically and sterically varied aryl reagents (**4a–4h**), 3-pyridyl groups (**4i** and **4j**), simple alkyl (**4k–4m**), as well as vinyl (**4n**) examples,

were all successfully employed. We were also able to include the complex arenes related to the pharmaceuticals sildenafil[33] (**4o**) and celecoxib (**4p**).[34] In general, sulfondiimidoyl fluorides **4** were stable, isolable molecules.

Conversion of sulfondiimidoyl fluorides into sulfondiimidamides

To achieve the conversion of the sulfondiimidoyl fluorides into the corresponding sulfondiimidamides, we investigated a range of Lewis acids, using fluoride **4a** and morpholine as the test substrates (see supplemental information; Table S2, for details). Of the Lewis acids investigated, $Ca(NTf_2)_2$ was superior,[35,36] affording excellent yields and clean reaction profiles; common side reactions with alternative Lewis acids included hydrolysis to a sulfonimidamide as well as a competing S_NAr reaction. Using the $Ca(NTf_2)_2$ conditions, the sulfondiimidoyl fluorides shown in Figure 2 were coupled with morpholine, leading to the corresponding sulfondiimidamides (**5a–5m**, **5o**, and **5p**) in generally high yields (Figure 3A). The one exception was the vinyl example (**4n**), which led to multiple unidentified products. Sulfondiimidamides **5a–5m**, **5o**, and **5p** featured a selection of aryl, heteroaryl, and alkyl carbon substituents, and all delivered stable molecules that were readily purified and characterized. Gram-scale, preparative reactions were possible, with 4.5 g of sulfondiimidamide **5a** being obtained in 90% yield. We next explored the variety of amines that could be used in these reactions; sulfondiimidamides **5q–5v** show that a broad range of cyclic secondary amines featuring varied substituents, including several motifs that are attractive in medicinal chemistry, can be combined with sulfondiimidoyl fluoride **4a** in high yields. In particular, the piperidine fragments from antiplatelet (clopidogrel, **5r**) and antipsychotic (risperidone, **5s**) agents, and piperazines that feature in the atypical antipsychotics perospirone and ziprasidone (**5t**), and the anti-Parkinson's compound Piribedal (**5u**), all performed well, in addition to the piperazine moiety that is the active pharmaceutical ingredient (API) in the antidepressant amoxapine (**5v**). An acyclic secondary amine (**5w**), 3-aminopyridine (**5x**), and tetramethyl guanidine (**5y**) could also be effectively introduced. The use of an enantiomerically enriched pyrrolidine generated the diastereomeric sulfondiimidamides **5z** and **5z′**, which could be separated by flash chromatography, and are the first examples of enantiomerically enriched, chiral at sulfur sulfondiimidamides to be isolated. The $Ca(NTf_2)_2$-promoted amination was poorly effective for primary amines, and ammonia, with minimal reactivity being observed, presumably due to catalyst deactivation from the strongly binding nucleophiles. We sought a more effective method that would allow additional amines to be used and turned to the use of an imidazolium derivative.[37] Imidazole could be employed as a nucleophile using $Ca(NTf_2)_2$ conditions to deliver sulfondiimidamide **5aa** in 88% yield (Figure 3B); this example also delivered crystals suitable for diffraction studies, and the resultant X-ray structure is shown, and confirms, the structural assignment. Imidazole derivative **5aa** proved to be a versatile intermediate; treatment with MeOTf activates the imidazole as a leaving group[37] and allows a more diverse range of amines to be introduced. Combining the *in-situ*-generated imidazolium with two equivalents of the N-nucleophiles (without additional base) allows simple primary amines (**5ab**), including cyclic (**5ac**), allylic (**5ad**), and sterically demanding (**5ae**) examples to be employed. Amino heterocycles (**5af–5ah**) and azoles (**5ai** and **5aj**) could also be effectively introduced. Sulfondiimidamide **5ak** features an oxazolidone, and **5al**/**5al′** are further examples of separable S-chiral derivatives. The final example, **5am**, is a primary sulfondiimidamide generated using ammonia as the nucleophile.

Synthetic manipulations of sulfondiimidamides

The sulfondiimidamides shown in Figure 3 establish that a wide range of carbon and nitrogen fragments can be introduced. We next explored reactions to demonstrate that intact sulfondiimidamides are amenable to functionalization (Figure 4). The primary-amidic sulfondiimidamide **5am** could be smoothly converted to the corresponding

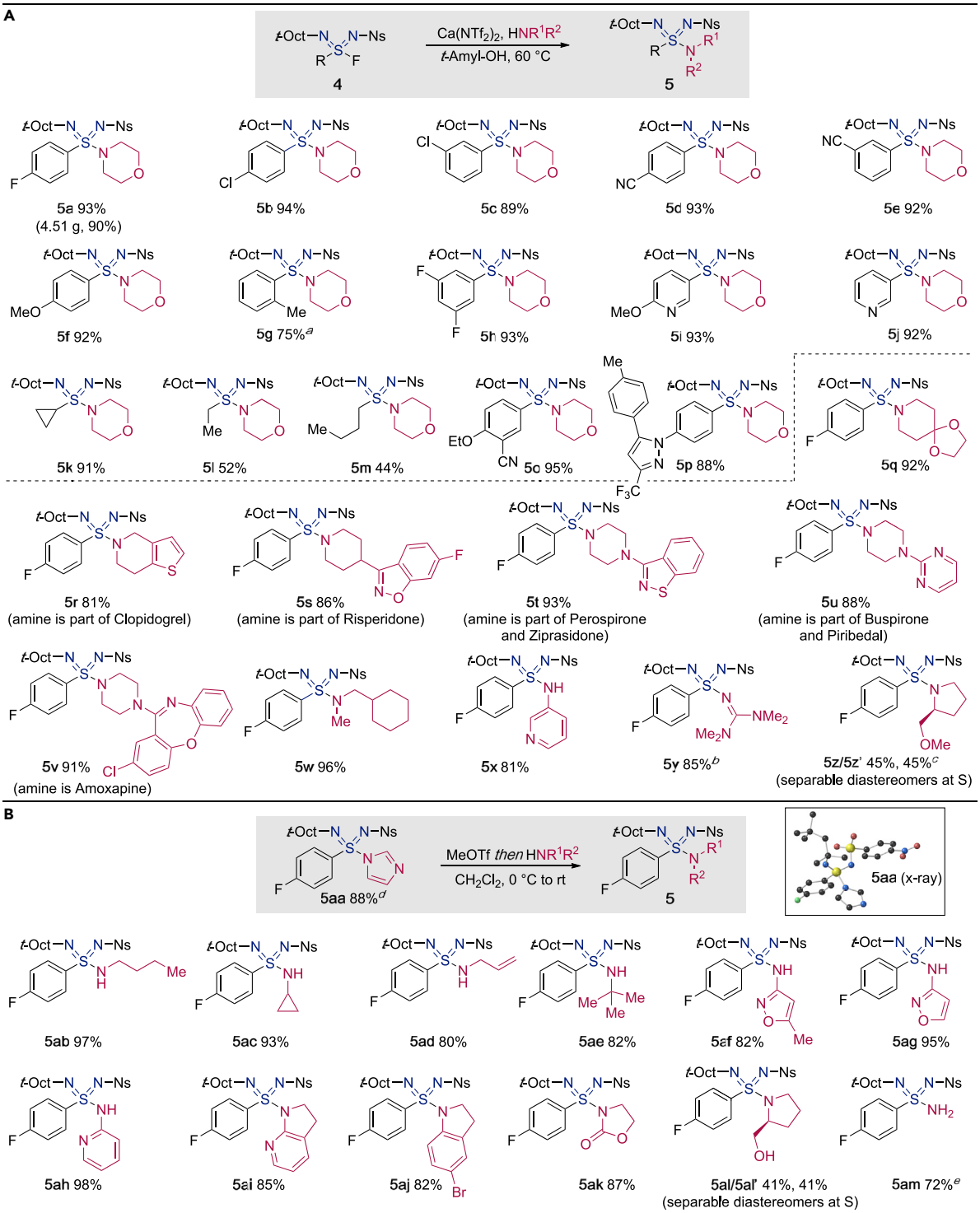

Figure 3. Conversion of sulfondiimidoyl fluorides into sulfondiimidamides

(A) The synthesis of sulfondiimidamides **5** from sulfondiimidoyl fluorides **4**. Reaction conditions: **4** (1.0 equiv), amine (2.2 equiv), $Ca(NTf_2)_2$ (1.1 equiv), *t*-Amyl-OH, 60°C, 10–36 h. Isolated yields.

(B) The synthesis of sulfondiimidamides **5** from imidazole sulfondiimidamide derivative **5aa** and X-ray crystal structure of **5aa.** Reaction conditions: **5aa** (1.0 equiv), MeOTf (1.05 equiv), CH_2Cl_2, 0°C, room temperature (RT) for 30 min, then amine (2.1 equiv), RT, 30 min. [a]Morpholine (4.0 equiv), 75°C. [b]TMG (3.0 equiv), 80°C. [c]70°C. [d]Imidazole (6.0 equiv), 65°C. [e]NH_3 2M in *i*-PrOH (4.0 equiv).

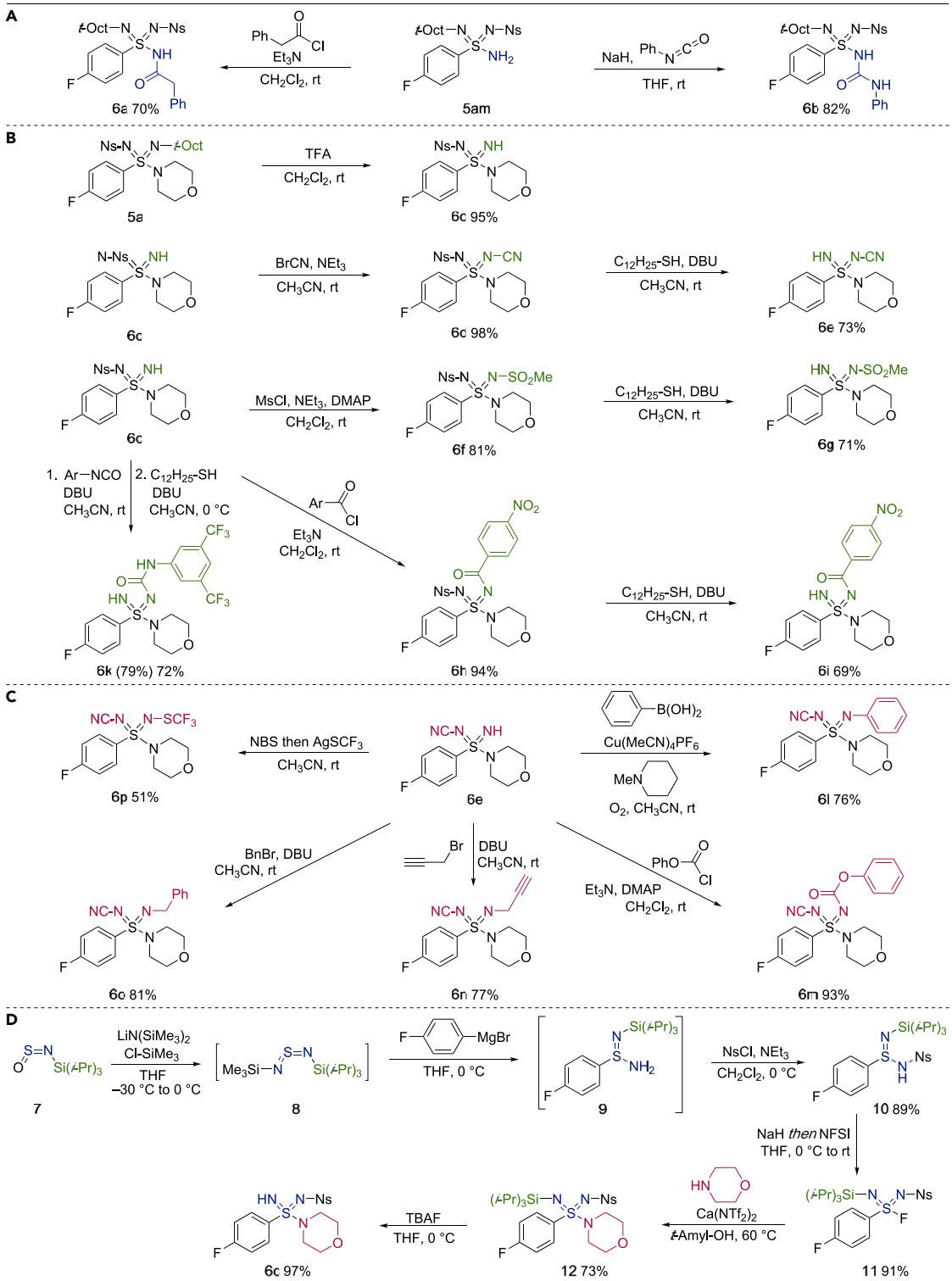

Figure 4. Functionalization and manipulation of sulfondiimidamides

(A) Functionalization of primary sulfondiimidamide **5am**.

(B) Removal of the *t*-octyl group from **5a**, followed by manipulation of the imidic N-substituents.

(C) Functionalization of N–CN derivative **6e**.

(D) Use of triisopropylsilyl sulfinylamine reagent **7** for the synthesis of N-silyl sulfondiimidamide **12** and the conversion of **12** to NH-derivative **6c**.

amide and urea derivatives (**6a** and **6b**, Figure 4A). The imidic N-substituents could also be manipulated. For example, treatment of N-*t*-octyl N-nosyl derivative **5a** with TFA in methylene chloride led to *t*-octyl cleavage and formation of imidic NH-derivative **6c** (Figure 4B). The imidic NH of **6c** was converted to a variety of functional groups; for example, treatment with cyanogen bromide provided N–CN derivative **6d**, the nosyl group of which was removed by treatment with dodecane thiol and DBU,[31] efficiently providing N–H N–CN derivative **6e**. Related two-stage procedures were used to introduce sulfonamide (**6g**), amide (**6i**), and urea (**6k**) functionality, each time partnered with a N–H substituent. Given the prominence of imidic N–CN substituents in known bioactive molecules,[38,39] we used N–CN derivative **6e** to further probe the compatibility of the sulfondiimidamide motif to the types of synthetic manipulations needed to introduce additional function (Figure 4C). Accordingly, aryl (**6l**),[40] carbamate (**6m**), propargyl (**6n**), benzyl (**6o**), and SCF_3 groups[41] (**6p**) were efficiently introduced, demonstrating tolerance to a range of reaction conditions, including transition metal catalysts, bases, oxidants, and reactive alkylating agents. These are in addition to the acidic conditions used to prepare N–H derivative **6c**.

To achieve maximum flexibility in the range of substituents that can be tolerated in our approach to sulfondiimidamides, we have also developed a complementary route that exploits an alternative sulfurdiimide reagent (Figure 4D). Unsymmetrical (bis-silyl)sulfurdiimide **8** can be prepared as before, but using tri-isopropylsilyl sulfinylamine **7** as the substrate.[42] The forward sequence then mirrors our earlier route, with organometallic addition (**8** → **9**), N-nosylation (**9** → **10**), S-fluorination (**10** → **11**), and then amine addition leading to sulfondiimidamide **12**. Importantly, from silyl-protected sulfondiimidamide **12**, the imidic N–H can be liberated by treatment with fluoride (TBAF), which is formally basic, in contrast to the acidic conditions needed to remove the *t*-octyl group, providing **6c** in 97% yield.

Synthesis of a celecoxib analog

As a demonstration of the utility of the developed chemistry, we prepared a direct sulfondiimidamide analog of the sulfonamide-containing non-steroidal anti-inflammatory drug (NSAID) celecoxib (Figure 5). Celecoxib inhibits COX-2, and given the reported success of N–CN substituted sulfoximines against this enzyme,[39] we selected an achiral bis(N–CN) sulfondiimidamide as our target. N-*t*-octyl, N–Ns sulfondiimidoyl fluoride **4p** was obtained as described in Figure 2 and then subjected to the three-step sequence of fluoride displacement with diallylamine, *t*-octyl cleavage, and installation of an imidic CN substituent to provide intermediate sulfondiimidamide **13**. From here, nosyl removal followed by installation of a second CN substituent delivered the diallyl-protected derivative **14**. De-allylation was then achieved using Pd(0) conditions to furnish the target structure (**15**) in a 93% yield for the final step. An alternative approach to sulfondiimidamide **15**, involving the ammonia displacement of a suitable imidazolium derivative (of the type generated from **5aa** in Figure 3B) was also considered, but the stability of the imidazole derivative to the acidic conditions needed to remove the imidic *t*-Oct-substituent precluded this route. One of the drivers for exploring sulfonimidamides in medicinal chemistry has been exploiting the oxygen to nitrogen exchange[15] as a method to tune physiochemical properties.[43,44] The additional oxygen to nitrogen switch present in sulfondiimidamides will allow further flexibility in these parameters. Accordingly, we have calculated select properties for celecoxib bis(N–CN)-sulfondiimidamide analog **15**, together with the parent molecule, celecoxib (**16**), and the related N–CN sulfonimidamide derivative (**17**) (Figure 5B). The calculations were performed using the SwissADME platform (see supplemental information for details)[45] and give an indication of the variations that will be possible with this approach.

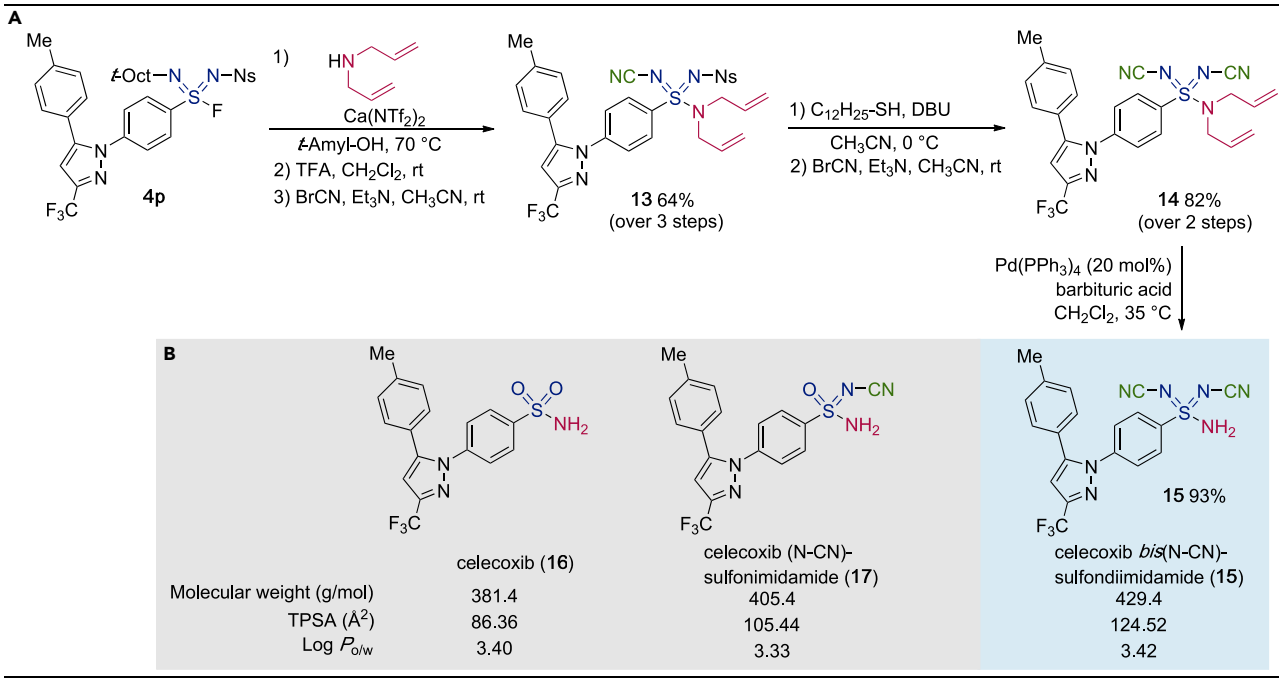

Figure 5. Synthesis of a sulfondiimidamide analogue of celecoxib

(A) Synthesis of bis(N–CN)-sulfondiimidamide celecoxib analog **15**.

(B) Comparison of calculated physical properties of **15** and related celecoxib-analogs.

Conclusions

In conclusion, we have shown that an efficient three-component assembly can be used to prepare sulfondiimidamides, that sulfondiimidamides can tolerate a variety of standard reaction conditions, that they are amenable to synthetic manipulation, and that this newly designed functional group is capable of supporting a variety of medicinal chemistry-relevant substituents. These features, together with the prominent role played by sulfur functional groups in the development of new medicines and agrochemicals, suggest that sulfondiimidamides will become a motif routinely employed in discovery chemistry.

EXPERIMENTAL PROCEDURES

Resource availability

Lead contact

Further information and requests for resources should be directed to and will be fulfilled by the lead contact, Michael Willis (michael.willis@chem.ox.ac.uk).

Materials availability

Reagents generated in this study will be made available on request, but we may require a payment and/or a completed materials transfer agreement if there is potential for commercial application.

Data and code availability

There is no dataset or code associated with this publication. Details of methods, experimental procedures, and characterization data are available in the supplemental information. Nuclear magnetic resonance (NMR) spectra are available (Data S1).

Crystallographic data for the structure reported in this article have been deposited at the Cambridge Crystallographic Data Centre, under deposition number CCDC: 2091794 (**5aa**).

SUPPLEMENTAL INFORMATION

Supplemental information can be found online at https://doi.org/10.1016/j.chempr.2022.02.013.

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AUTHOR CONTRIBUTIONS

Z.-X.Z. and M.C.W. conceived the project. Z.-X.Z. performed the experimental studies. Z.-X.Z. and M.C.W. wrote the manuscript. Both authors contributed to the analysis and interpretation of the data and commented on the final draft of the manuscript. M.C.W. directed the project.

DECLARATION OF INTERESTS

The authors have submitted a patent application related to this work.

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Chem, Volume *8*

Supplemental information

Sulfondiimidamides as new functional groups for synthetic and medicinal chemistry

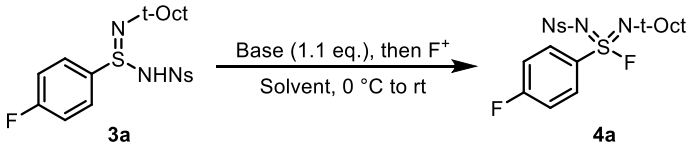
Ze-Xin Zhang and Michael C. Willis

Supplemental Information - Contents

1. Optimization Details

1.1 Optimization of Sulfondiimidoyl Fluoride Synthesis

Table S1. Optimization of sulfondiimidoyl fluoride 4a synthesis



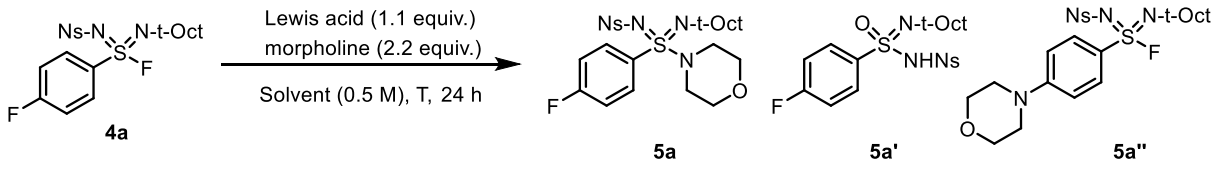
3a **4a**

Entry[a]	Solvent	Base	F^+ (eq.)	Yield
1	DMF (0.5 M)	NaH	NFSI (1.5 eq.)	57%
2	Et_2O (0.5 M)	NaH	NFSI (1.5 eq.)	10%
3	MeCN (0.5 M)	NaH	NFSI (1.5 eq.)	11%
4	1,4-dioxane (0.5 M)	NaH	NFSI (1.5 eq.)	7%
5	EtOAc (0.5 M)	NaH	NFSI (1.5 eq.)	36%
6	**THF (0.5 M)**	**NaH**	**NFSI (1.5 eq.)**	**68% (70%[b])**
7	THF (0.5 M)	NaH	NFSI (2.0 eq.)	66%
8	THF (0.1 M)	NaH	NFSI (2.0 eq.)	61%
9	THF (0.5 M)	NaH	NFSI (4.0 eq.)	64%
10	THF (0.5 M)	NaH	NFSI (2.0 eq.)	63%
11	THF (0.2 M)	NaH	Selectfluor (3.0 eq.)	0%[c]
12	THF (0.1 M)	K_2CO_3	NFSI (1.1 eq)	0%[c]
13	THF (0.5 M)	Et_3N	NFSI (1.5 eq.)	0%[c]
14	THF (0.5 M)	-	NFSI (1.5 eq.)	0%[c]

a. Reaction conditions: sulfinamidine **3a** (1.0 equiv.), base (1.1 equiv.), solvent, 0 °C for 5 min, then rt for 25 min. Then NFSI or Selectfluor, rt, 30 min. Aqueous workup. 20 h. Isolated yields. ***b***. 15-crown-5 (1.1 equiv.) used as the additive. ***c***. Starting material recovered.

1.2 Optimization of Sulfondiimidamide Synthesis

Table S2. Optimization of sulfondiimidamide 5a synthesis



Entry[a]	Lewis acid	Solvent	T	Yield of **5a**	Yield of **5a'**	Yield of **5a''**
1	$In(OTf)_3$	*t*-AmylOH	60 °C	0%	77%	0%
2	$Cu(OTf)_2$	*t*-AmylOH	60 °C	0%	0%	0%
3	$Ca(OTf)_2$	*t*-AmylOH	60 °C	29%	0%	8%
4	**$Ca(NTf_2)_2$**	***t*-AmylOH**	**60 °C**	**93%**	0%	0%
5	$Mg(NTf_2)_2$	*t*-AmylOH	60 °C	55%	0%	0%
6	$Ba(NTf_2)_2$	*t*-AmylOH	60 °C	64%	0%	0%
7	$Ca(NTf_2)_2$	MeOH	60 °C	40%	0%	0%
8	$Ca(NTf_2)_2$	MeCN	60 °C	87%	0%	0%
9	$Ca(NTf_2)_2$	THF	60 °C	87%	0%	0%
10[b]	-	MeCN	60 °C	0%	0%	84%
11	$Ca(NTf_2)_2$	*t*-AmylOH	40 °C	73%	0%	0%
12	$Ca(NTf_2)_2$ (0.5 eq.)	*t*-AmylOH	60 °C	47%	0%	5%

a. Reaction conditions: sulfondiimidoyl fluoride **4a** (1.0 equiv.), Lewis acid, morpholine (2.2 equiv.), solvent (0.5 M), 24 h. Isolated yields. ***b***. DBU (2.0 equiv.) used as the additive, 15 h.

2. Experimental

2.1 General Considerations

Handling techniques: Reactions were performed under inert nitrogen atmosphere with anhydrous solvent unless otherwise stated. All glassware was oven-dried at >100 °C and allowed to cool to room temperature under a positive pressure of nitrogen before use. Reactions were monitored by TLC until deemed complete using aluminum backed silica plates. Plates were visualised under ultraviolet light (λ_{max} = 254 nm) and/or by staining with $KMnO_4$ solution. Cooling of reaction mixtures to 0 °C was achieved using an ice-water bath. Cooling of reaction mixtures to -78 °C was achieved using a dry ice-acetone bath. 'Room temperature' refers to an ambient temperature of 21 ± 2 °C.

Reagents: Reagents were purchased from Sigma-Aldrich Chemical Co. Ltd., Alfa Aesar, Tokyo Chemical Industry UK or Fluorochem Ltd. and were used as supplied. *N*-Sulfinyl-*tert*-octylamine was prepared according to literature method.[1] Anhydrous solvents were purified by filtration through dried alumina columns using the University of Oxford internal solvent drying system (Innovative Technology Inc. PS-400-7) and sparged with nitrogen before use. All inert gases were sourced from the University of Oxford internal supplies and dried through $CaCl_2$ drying columns. Grignard reagents were titrated against a solution of salicylaldehyde phenylhydrazone.[2] Flash column chromatography was carried out using matrix 60 silica gel. 'Petrol' refers to the fraction of petroleum ether which boils in the range 40-60 °C.

NMR Spectroscopy: ^{1}H-NMR spectra were obtained on a Bruker AVIII400 (400 MHz) spectrometer. ^{13}C-NMR spectra were obtained on a Bruker AVIII400 (101 MHz). ^{19}F-NMR spectra were obtained on a Bruker AVIII400 (377 MHz) spectrometer. All reported ^{1}H and ^{13}C chemical shifts (δ_H, δ_C) are referenced to the residual signal of deuterated solvents ($CDCl_3$: δ_H = 7.26 ppm, δ_C = 77.16 ppm; $(CD_3)_2SO$: δ_H = 2.50 ppm, δ_C = 39.52 ppm; $(CD_3)_2CO$: δ_H = 2.05 ppm, δ_C = 206.26 ppm; CD_3CN: δ_H = 1.94 ppm, δ_C = 118.26 ppm; C_6D_6: δ_H = 7.16 ppm, δ_C = 128.06 ppm). ^{19}F chemical shifts (δ_F) are referenced externally to $CFCl_3$ (δ_F = 0.0 ppm). Chemical shifts (δ) are reported in parts per million (ppm) to the nearest 0.01 ppm for ^{1}H NMR, and 0.1 ppm for ^{13}C and ^{19}F NMR. Coupling constants (*J*) are reported in Hertz (Hz). Multiplicities are reported as followings: s (singlet), d (doublet), t (triplet), q (quartet), pent. (pentet), m (multiplet), br. (broad signal), app. (apparent).

Mass Spectroscopy: Low resolution ESI mass spectra were recorded on a Waters LCT Premier spectrometer. High resolution mass spectrometry measurements were recorded on a Bruker

Daltronics MicroTOF (ESI) spectrometer or on a Micromass LCT (FI) spectrometer by the internal service at Chemistry Research Laboratory, University of Oxford. Samples for mass spectra were prepared as 1 mg/mL solution in MeOH (LRMS, HRMS-ESI) or submitted neat (HRMS-FI).

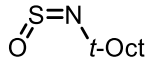
IR Spectroscopy: Infrared spectra were recorded as thin films on a Bruker Tensor 27 FT-IR spectrometer.

Melting point: Melting points were measured using a Stuart Scientific Melting Point Apparatus SMP1.

Optical rotation: Optical rotations were measured on a Schmidt Haensch UniPol L2000 polarimeter at 589 nm, 25 °C. $[\alpha]_D^T$ is expressed in deg cm^3 g^{-1} dm^{-1} and c is expressed in g/100 cm^3.

2.2 Synthetic Procedures and Characterisation Data

2.2.1 Preparation of *N*-sulfinyl-*tert*-octylamine



Tert-Octylamine (5.17 g, 40.0 mmol, 1.00 equiv.) was dissolved in anhydrous diethyl ether (200 mL) in a 500 mL 3-necked round bottom flask. Anhydrous triethylamine (11.49 mL, 82.4 mmol, 2.06 equiv.) was added and the reaction was cooled to 0 °C. Freshly distilled thionyl chloride (2.99 mL, 41.2 mmol, 1.03 equiv.) was added dropwise. The reaction was stirred at 0 °C for 2 h. Filtration through Celite® (washed with anhydrous diethyl ether) and removal of solvent under reduced pressure afforded *N*-sulfinyl-*tert*-octylamine as a yellow oil (6.65 g, 38.0 mmol, 95%).

Notes

1. *N*-Sulfinyl-*tert*-octylamine should be stored in the freezer (-20 °C) and can be used without loss of performance for at least 2 months. Prolonged contact with air or storage at room temperature should be avoided.
2. **CAUTION: Hydrolysis of sulfinylamines results in the formation of toxic sulfur dioxide gas.** Evolution of SO_2 from *N*-sulfinyl-*tert*-octylamine has not been noted by the authors in the normal course of use, but avoidance of contact with water or prolonged storage at room temperature is advised.
3. *tert*-Octylamine was purchased from Sigma-Aldrich and used without further purification.
4. The product may be further purified by vacuum distillation at 65 °C/5 mbar, but this was not necessary. Use of high temperatures during distillation may result in decomposition of the product.

The data was consistent with the literature [1].

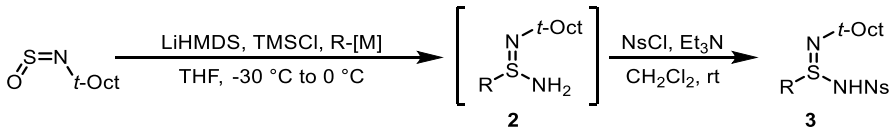
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 1.73 (s, 2H), 1.60 (s, 6H), 1.02 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 67.7, 55.5, 32.2, 31.5, 31.2

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 2888, 1382, 1252, 1152, 1073, 954;

HRMS (EI^+) calcd. for $C_8H_{18}NOS^+$ $[M+H]^+$: 176.1104; found: 176.1106.

2.2.2 General Procedure A for Sulfinamidine Synthesis



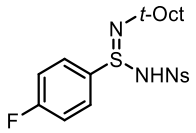
N-Sulfinyl-*tert*-octylamine (1.00 equiv.) was dissolved in anhydrous THF (0.5 M) in an oven-dried round-bottom flask and was purged with nitrogen gas. The mixture was cooled to -30 °C before LiHMDS solution (1.00 M in THF, 1.00 equiv.) was added. After being stirred at - 30 °C for 5 min, the reaction was warmed to 0 °C and stirred for another 5 min. TMSCl (1.00 equiv.) was added and the reaction was stirred at 0 °C for 10 min. Then the corresponding organometallic reagent (1.20 equiv.) was added. The reaction was stirred at 0 °C for 10 min before being quenched with sat. aq. tetrasodium EDTA solution. Ethyl acetate was added and the organic layer was separated. The aqueous layer was further extracted with ethyl acetate twice. The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude mixture was dissolved in anhydrous CH_2Cl_2 (0.2 M) in an oven-dried round-bottom flask. Then Et_3N (1.20 equiv.) and NsCl (1.10 equiv.) were added. The reaction was stirred at room temperature for 1 h. The reaction was then quenched with sat. aq. NaCl solution and extracted with CH_2Cl_2 three times. The combined organic layers were dried over anhydrous Na_2SO_4, filtered, concentrated under reduced pressure and purified by flash column chromatography to afford sulfinamidine **3**.

Notes:

1. *Tert*-octyl-protected primary sulfinamidines **2** are sensitive to moisture and heat. For this reason, during the work-up stage volatiles were removed in a rotary evaporator with the bath temperature set to 30 °C or lower. In addition, *tert*-octyl-protected primary sulfinamidines were not purified by flash column chromatography and instead were used as a crude mixture immediately in the following nosylation step without further purification.
2. If the organometallic reagents were prepared at -78 °C, the *in-situ* generated sulfurdiimide reagent was added to the organometallic reagents at -78 °C. The reaction was then warmed to 0 °C and stirred at 0 °C for 10 min before being quenched with sat. aq. tetrasodium EDTA solution.
3. If the final sulfinamidine product is not sufficiently pure after flash column chromatography,

the impure solid product can be further purified by washing with diethyl ether or additional flash column chromatography.

_N_-(_S_-(4-Fluorophenyl)-_N_-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3a)



_N_-Sulfinyl-_tert_-octylamine (2.75 g, 15.68 mmol, 1.00 equiv.) was dissolved in anhydrous THF (31.4 mL) in an oven-dried 250 mL round-bottom flask and was purged with nitrogen gas. The mixture was cooled to -30 °C before LiHMDS solution (15.68 mL, 1.00 M in THF, 15.68 mmol, 1.00 equiv.) was added. After being stirred at - 30 °C for 5 min, the reaction was warmed to 0 °C and stirred for another 5 min. TMSCl (1.99 mL, 15.68 mmol, 1.00 equiv.) was added and the reaction was stirred at 0 °C for 10 min. 4-Fluorophenylmagnesium bromide solution (19.20 mL, 0.98 M in THF, 18.82 mmol, 1.20 equiv.) was then added and the reaction was stirred at 0 °C for 10 min. The reaction mixture was then quenched with sat. aq. tetrasodium EDTA solution (300 mL). Ethyl acetate (150 mL) was added and the organic layer was separated. The aqueous layer was further extracted with ethyl acetate (2 × 80 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude mixture was dissolved in anhydrous CH_2Cl_2 (78.0 mL) in an oven-dried 250 mL round-bottom flask before Et_3N (2.62 mL, 18.82 mmol, 1.20 equiv.) and NsCl (3.82 g, 17.25 mmol, 1.10 equiv.) were added. The reaction was stirred at room temperature for 1 h until completion (judged by TLC). The reaction was quenched with sat. aq. NaCl solution (250 mL) and extracted with CH_2Cl_2 (3 × 100 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered, concentrated under reduced pressure and purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 30:1 to 20:1) to afford *sulfinamidine* **3a** as a white solid (6.23 g, 13.69 mmol, 87%).

mp 118-120 °C;

R_f 0.57 (CH_2Cl_2/ethyl acetate, 15:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.21 (d, J = 8.8 Hz, 2H), 7.96 (d, J = 8.8 Hz, 2H), 7.67-7.47 (m, 2H), 7.19-6.89 (m, 2H), 4.48 (s, 1H), 1.65 (d, J = 15.0 Hz, 1H), 1.61 (d, J = 15.0 Hz, 1H), 1.48 (s, 3H), 1.44 (s, 3H), 0.97 (s, 9H);

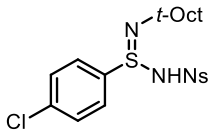
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.7 (d, J = 254.7 Hz), 150.2, 149.2, 133.5 (d, J = 3.1 Hz), 129.4 (d, J = 9.1 Hz), 127.3, 124.0, 116.8 (d, J = 22.9 Hz), 60.6, 55.6, 31.8, 31.7, 30.7, 29.1 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -106.7 (tt, J = 8.0, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1490, 1349, 1290, 1145, 1088, 982, 618;

HRMS (ESI^+) calcd. for $C_{20}H_{27}FN_3O_4S_2^+$ $[M+H]^+$: 456.1422, found: 456.1421.

_N_-(S-(4-Chlorophenyl)-_N_-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3b)



Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.27 g, 7.23 mmol, 1.00 equiv.), THF (14.5 mL), LiHMDS solution (7.23 mL, 1.00 M in THF, 7.23 mmol, 1.00 equiv.), TMSCl (0.92 mL, 7.23 mmol, 1.00 equiv.), 4-chlorophenylmagnesium bromide solution (9.85 mL, 0.88 M in 2-methyltetrahydrofuran, 8.67 mmol, 1.20 equiv.), CH_2Cl_2 (36.0 mL), Et_3N (1.21 mL, 8.68 mmol, 1.20 equiv.) and NsCl (1.76 g, 7.95 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 50:1 to 30:1 to 20:1) afforded *sulfinamidine* **3b** as a white solid (3.01 g, 6.39 mmol, 88%).

mp 110-112 °C;

R_f 0.40 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.23 (d, J = 8.9 Hz, 2H), 7.96 (d, J = 8.9 Hz, 2H), 7.54 (d, J = 8.8 Hz, 2H), 7.39 (d, J = 8.8 Hz, 2H), 4.49 (s, 1H), 1.67 (d, J = 14.9 Hz, 1H), 1.63 (d, J = 14.9 Hz, 1H), 1.51 (s, 3H), 1.47 (s, 3H), 0.99 (s, 9H);

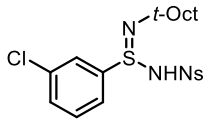
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.2, 149.2, 138.7, 136.6, 129.8, 128.4, 127.3, 124.1, 60.7, 55.7, 31.81, 31.75, 30.7, 29.2 (note: for *gem*-dimethyl carbons in *tert*-octyl group,

NC***(CH₃)₂***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1527, 1349, 1290, 1145, 1088, 982, 745, 620;

HRMS (ESI^+) calcd. for $C_{20}H_{27}ClN_3O_4S_2^+$ $[M+H]^+$: 472.1126, found: 472.1125.

_N_-(_S_-(3-Chlorophenyl)-_N_-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3c)



Preparation of Grignard reagent

3-Chlorophenylmagnesium chloride lithium chloride complex solution was prepared according to the following procedure. To a solution of 1-bromo-3-chlorobenzene (1.61 g, 8.40 mmol, 1.20 equiv.) in anhydrous THF (8.4 mL) in an oven-dried 100 mL round-bottom flask was added isopropylmagnesium chloride lithium chloride complex solution (Turbo Grignard Reagent, 6.72 mL, 1.25 M in THF, 8.40 mmol, 1.20 equiv.) dropwise at 0 °C. The reaction was stirred at the same temperature for 3.5 h.

Preparation of sulfinamidine

Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.23 g, 7.00 mmol, 1.00 equiv.), THF (14.0 mL), LiHMDS solution (7.00 mL, 1.00 M in THF, 7.00 mmol, 1.00 equiv.), TMSCl (0.89 mL, 7.00 mmol, 1.00 equiv.), 3-chlorophenyl magnesium chloride lithium chloride complex solution (8.40 mmol, 1.20 equiv.), CH_2Cl_2 (35.0 mL), Et_3N (1.17 mL, 8.40 mmol, 1.20 equiv.) and NsCl (1.71 g, 7.70 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 50:1 to 30:1) afforded *sulfinamidine* **3c** as a white solid (2.15 g, 4.56 mmol, 65%).

mp 104-106 °C;

R_f 0.45 (CH_2Cl_2/ethyl acetate, 20:1);

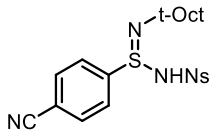
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.23 (d, *J* = 8.8 Hz, 2H), 7.94 (d, *J* = 8.8 Hz, 2H), 7.52-7.47 (m, 2H), 7.46-7.41 (m, 1H), 7.40-7.34 (m, 1H), 4.59 (s, 1H), 1.71 (d, *J* = 14.9 Hz, 1H), 1.66 (d, *J* = 14.9 Hz, 1H), 1.53 (s, 3H), 1.51 (s, 3H), 1.02 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.1, 149.3, 139.8, 135.8, 132.1, 130.7, 127.3, 127.2, 125.3, 124.1, 60.9, 55.7, 31.9, 31.8, 30.9, 29.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1527, 1462, 1383, 1349, 1290, 1251, 1147, 1087, 957, 855, 732, 678, 618;

HRMS (ESI^+) calcd. for $C_{20}H_{27}ClN_3O_4S_2^+$ $[M+H]^+$: 472.1126, found: 472.1125.

_N_-(_S_-(4-Cyanophenyl)-_N_-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3d)



Preparation of Grignard reagent

4-Cyanophenylmagnesium chloride lithium chloride complex solution was prepared according to the following procedure. To a solution of 4-bromobenzonitrile (1.53 g, 8.40 mmol, 1.20 equiv.) in anhydrous THF (8.4 mL) in an oven-dried 100 mL round-bottom flask was added isopropylmagnesium chloride lithium chloride complex solution (Turbo Grignard Reagent, 6.89 mL, 1.22 M in THF, 8.40 mmol, 1.20 equiv.) dropwise at 0 °C. The reaction was stirred at room temperature for 1.5 h.

Preparation of sulfinamidine

Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.23 g, 7.00 mmol, 1.00 equiv.), THF (14.0 mL), LiHMDS solution (7.00 mL, 1.00 M in THF, 7.00 mmol, 1.00 equiv.), TMSCl (0.89 mL, 7.00 mmol, 1.0 equiv.), 4-cyanophenyl magnesium chloride lithium chloride complex solution (8.40 mmol, 1.20 equiv.), CH_2Cl_2 (35.0 mL), Et_3N (1.17 mL, 8.40 mmol, 1.20 equiv.) and NsCl (1.71 g, 7.70 mmol, 1.10 equiv.). Purification by flash column chromatography

(CH_2Cl_2/ethyl acetate, 25:1 to 15:1 to 10:1) afforded *sulfinamidine* **3d** as a white solid (2.16 g, 4.68 mmol, 67%).

mp 126-128 °C;

R_f 0.34 (CH_2Cl_2/ethyl acetate, 15:1);

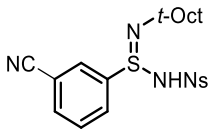
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.27 (d, *J* = 8.8 Hz, 2H), 8.02 (d, *J* = 8.8 Hz, 2H), 7.82 (d, *J* = 8.8 Hz, 2H), 7.76 (d, *J* = 8.8 Hz, 2H), 4.54 (s, 1H), 1.68 (d, *J* = 14.9 Hz, 1H), 1.64 (d, *J* = 14.9 Hz, 1H), 1.51 (s, 3H), 1.46 (s, 3H), 1.00 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.9, 149.5, 143.7, 133.2, 128.0, 127.4, 124.2, 117.2, 116.0, 61.1, 55.8, 31.9, 31.8, 30.7, 29.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1527, 1349, 1289, 1144, 1087, 982, 855, 732, 618;

HRMS (ESI^+) calcd. for $C_{21}H_{27}N_4O_4S_2^+$ $[M+H]^+$: 463.1468, found: 463.1462.

_N_-(_S_-(3-Cyanophenyl)-_N_-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3e)



Preparation of Grignard reagent

3-Cyanophenylmagnesium chloride lithium chloride complex solution was prepared according to the following procedure. To a solution of 3-bromobenzonitrile (1.53 g, 8.40 mmol, 1.20 equiv.) in anhydrous THF (8.4 mL) in an oven-dried 100 mL round-bottom flask was added isopropylmagnesium chloride lithium chloride complex solution (Turbo Grignard Reagent) (6.83 mL, 1.23 M in THF, 8.40 mmol, 1.20 equiv.) dropwise at 0 °C. The reaction was stirred at room temperature for 2.5 h.

Preparation of sulfinamidine

Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.23 g, 7.00 mmol, 1.00 equiv.), THF (14.0 mL), LiHMDS solution (7.00 mL, 1.00 M in THF, 7.00 mmol, 1.00 equiv.), TMSCl (0.89 mL, 7.00 mmol, 1.00 equiv.), 3-cyanophenyl magnesium chloride lithium chloride complex solution (8.40 mmol, 1.20 equiv.), CH_2Cl_2 (35.0 mL), Et_3N (1.17 mL, 8.40 mmol, 1.20 equiv.) and NsCl (1.71 g, 7.70 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 25:1 to 15:1 to 10:1) afforded *sulfinamidine* **3e** as a white solid (2.86 g, 6.19 mmol, 88%).

mp 102-104 °C;

R$_f$ 0.57 (CH_2Cl_2/ethyl acetate, 15:1);

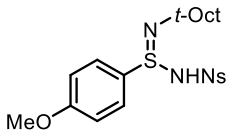
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.27 (d, J = 8.9 Hz, 2H), 8.00 (d, J = 8.9 Hz, 2H), 7.93-7.87 (m, 2H), 7.78 (dt, J = 7.7, 1.3 Hz, 1H), 7.60 (td, J = 7.7, 0.7 Hz, 1H), 4.66 (s, 1H), 1.69 (d, J = 14.9 Hz, 1H), 1.65 (d, J = 14.9 Hz, 1H), 1.51 (s, 3H), 1.47 (s, 3H), 1.01 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.9, 149.5, 140.6, 135.2, 131.4, 130.8, 130.5, 127.4, 124.2, 117.1, 114.2, 61.1, 55.7, 31.9, 31.8, 30.6, 29.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1527, 1349, 1291, 1145, 1087, 981, 855, 732, 684, 619;

HRMS (ESI$^+$) calcd. for $C_{21}H_{27}N_4O_4S_2^+$ $[M+H]^+$: 463.1468, found: 463.1463.

_N_-(_S_-(4-Methoxyphenyl)-_N_-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3f)



Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.26 g, 7.17 mmol, 1.00 equiv.), THF (14.3 mL), LiHMDS solution (7.17 mL, 1.00 M in THF, 7.23 mmol, 1.00 equiv.), TMSCl (0.91 mL, 7.17 mmol, 1.00 equiv.), 4-methoxyphenylmagnesium bromide solution (17.20 mL, 0.50 M in THF, 8.60 mmol, 1.20 equiv.), CH_2Cl_2 (35.9 mL), Et_3N (1.20 mL, 8.60 mmol, 1.20

equiv.) and NsCl (1.75 g, 7.89 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 30:1 to 20:1 to 10:1) afforded *sulfinamidine* **3f** as a white solid (2.54 g, 5.44 mmol, 76%).

mp 108-110 °C;

R_f 0.2 (petrol/ethyl acetate, 2:1);

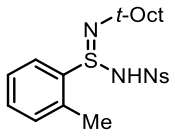
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.19 (d, J = 8.8 Hz, 2H), 7.94 (d, J = 8.8 Hz, 2H), 7.48 (d, J = 9.0 Hz, 2H), 6.88 (d, J = 9.0 Hz, 2H), 4.35 (s, 1H), 3.80 (s, 3H), 1.68 (d, J = 15.0 Hz, 1H), 1.63 (d, J = 15.0 Hz, 1H), 1.52 (s, 3H), 1.49 (s, 3H), 1.00 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 162.5, 150.5, 149.1, 128.7, 128.5, 127.3, 124.0, 114.9, 60.4, 55.8, 55.7, 31.83, 31.79, 30.9, 29.2 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1526, 1494, 1348, 1287, 1257, 1143, 1085, 1017, 980, 731, 616;

HRMS (ESI^+) calcd. for $C_{21}H_{30}N_3O_5S_2^+$ $[M+H]^+$: 468.1621, found: 468.1620.

4-Nitro-*N*-(*S*-(*o*-tolyl)-*N*-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)benzenesulfonamide (3g)



Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.23 g, 7.00 mmol, 1.00 equiv.), THF (14.0 mL), LiHMDS solution (7.00 mL, 1.00 M in THF, 7.00 mmol, 1.00 equiv.), TMSCl (0.89 mL, 7.00 mmol, 1.00 equiv.), 2-methylphenylmagnesium bromide solution (13.10 mL, 0.64 M in THF, 8.40 mmol, 1.20 equiv.), CH_2Cl_2 (14.0 mL), Et_3N (1.95 mL, 14.00 mmol, 2.00 equiv.) and NsCl (2.33 g, 10.50 mmol, 1.50 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 60:1 to 30:1 to 20:1) afforded *sulfinamidine* **3g** as a white solid (2.58 g, 5.72 mmol, 82%).

mp 110-112 °C;

R_f 0.36 (CH_2Cl_2/ethyl acetate, 30:1);

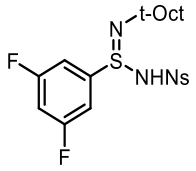
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.08 (d, *J* = 8.9 Hz, 2H), 7.94 (dd, *J* = 7.4, 1.9 Hz, 1H), 7.75 (d, *J* = 8.9 Hz, 2H), 7.38-7.29 (m, 2H), 7.09-7.05 (m, 1H), 4.49 (s, 1H), 2.36 (s, 3H), 1.70 (d, *J* = 14.9 Hz, 1H), 1.65 (d, *J* = 14.9 Hz, 1H), 1.57 (s, 3H), 1.51 (s, 3H), 0.99 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.1, 148.9, 136.6, 136.2, 132.3, 131.6, 127.2, 127.1, 125.6, 123.7, 60.8, 55.7, 31.82, 31.75, 30.5, 29.2, 19.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1526, 1348, 1286, 1143, 1088, 968, 731, 616;

HRMS (ESI^+) calcd. for $C_{21}H_{30}N_3O_4S_2^+$ $[M+H]^+$: 452.1672, found: 452.1669.

***N*-(*S*-(3,5-Difluorophenyl)-*N*-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3h)**



Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.02 g, 5.82 mmol, 1.00 equiv.), THF (11.6 mL), LiHMDS solution (5.82 mL, 1.00 M in THF, 5.82 mmol, 1.00 equiv.), TMSCl (0.74 mL, 5.82 mmol, 1.00 equiv.), 3,5-difluorophenylmagnesium bromide solution (29.10 mL, 0.24 M in THF, 6.98 mmol, 1.20 equiv.), CH_2Cl_2 (29.1 mL), Et_3N (0.97 mL, 6.98 mmol, 1.20 equiv.) and NsCl (1.42 g, 6.40 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 50:1 to 25:1) afforded *sulfinamidine* **3h** as a white solid (2.36 g, 4.99 mmol, 86%).

mp 110-112 °C;

R_f 0.50 (CH_2Cl_2/ethyl acetate, 25:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.26 (d, J = 8.9 Hz, 2H), 7.99 (d, J = 8.9 Hz, 2H), 7.17-7.12 (m, 2H), 6.92 (tt, J = 8.3, 2.3 Hz, 1H), 4.68 (s, 1H), 1.69 (d, J = 14.9 Hz, 1H), 1.65 (d, J = 14.9 Hz, 1H), 1.50 (s, 3H), 1.47 (s, 3H), 1.01 (s, 9H);

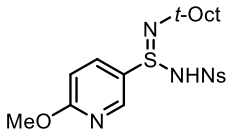
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 163.0 (dd, J = 255.2, 11.8 Hz), 149.9, 149.4, 142.2 (t, J = 8.5 Hz), 127.4, 124.2, 111.8-110.2 (second-order multiplet), 107.6 (t, J = 25.1 Hz), 61.1, 55.7, 31.83, 31.75, 30.6, 29.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);**^{19}F NMR** (377 MHz, $CDCl_3$): δ (ppm) = -104.7 – -104.8 (second-order multiplet);

The second-order multiplet in the ^{13}C and ^{19}F NMR spectra arise due to virtual coupling;

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1600, 1528, 1437, 1349, 1291, 1146, 1125, 1088, 990, 855, 731, 619;

HRMS (ESI^+) calcd. for $C_{20}H_{26}F_2N_3O_4S_2^+$ $[M+H]^+$: 474.1327, found: 474.1319.

_N_-(6-Methoxy-_N_-(2,4,4-trimethylpentan-2-yl)pyridine-3-sulfinimidoyl)-4-nitrobenzenesulfonamide (3i)



Preparation of organometallic reagent

(6-Methoxypyridin-3-yl)lithium solution was prepared according to the following procedure. To a solution of 5-bromo-2-methoxypyridine (1.74 g, 9.25 mmol, 1.20 equiv.) in anhydrous THF (18.5 mL) in an oven-dried 100 mL round-bottom flask was added *n*-butyllithium solution (3.70 mL, 2.50 M in hexanes, 9.25 mmol, 1.20 equiv.) dropwise at -78 °C. The reaction was stirred at the same temperature for 40 min.

Preparation of sulfinamidine

Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.35 g, 7.71 mmol, 1.00 equiv.), THF (15.4 mL), LiHMDS solution (7.71 mL, 1.00 M in THF, 7.71 mmol, 1.00 equiv.), TMSCl (0.98 mL, 7.71 mmol, 1.00 equiv.), (6-methoxypyridin-3-yl)lithium solution (9.25 mmol, 1.20 equiv.), CH_2Cl_2 (38.5 mL), Et_3N (1.29 mL, 9.25 mmol, 1.20 equiv.) and NsCl (1.88 g, 8.47

mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 25:1 to 15:1 to 5:1) afforded *sulfinamidine* **3i** as a white solid (2.89 g, 6.18 mmol, 80%).

mp 120-122 °C;

R_f 0.38 (CH_2Cl_2/ethyl acetate, 10:1);

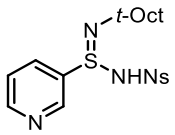
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.28 (dd, *J* = 2.7, 0.7 Hz, 1H), 8.21 (d, *J* = 8.8 Hz, 2H), 7.94 (d, *J* = 8.8 Hz, 2H), 7.71 (dd, *J* = 8.9, 2.7 Hz, 1H), 6.73 (dd, *J* = 8.9, 0.7 Hz, 1H), 4.60 (s, 1H), 3.91 (s, 3H), 1.66 (d, *J* = 15.0 Hz, 1H), 1.64 (d, *J* = 15.0 Hz, 1H), 1.51 (s, 3H), 1.48 (s, 3H), 1.00 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.3, 150.2, 149.2, 146.7, 137.0, 127.3, 126.7, 124.1, 112.0, 60.7, 55.6, 54.4, 31.82, 31.76, 30.7, 29.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1588, 1527, 1478, 1371, 1349, 1285, 1145, 1087, 1015, 979, 732, 619;

HRMS (ESI^+) calcd. for $C_{20}H_{29}N_4O_5S_2^+$ $[M+H]^+$: 469.1574, found: 469.1570.

4-Nitro-*N*-(*N*-(2,4,4-trimethylpentan-2-yl)pyridine-3-sulfinimidoyl)benzenesulfonamide (3j)



Preparation of Grignard reagent

3-Pyridylmagnesium chloride lithium chloride complex solution was prepared according to the following procedure. To a solution of 3-bromopyridine (1.32 g, 8.40 mmol, 1.20 equiv.) in anhydrous THF (8.4 mL) in an oven-dried 100 mL round-bottom flask was added isopropyl magnesium chloride lithium chloride complex solution (Turbo Grignard Reagent, 6.83 mL, 1.23 M in THF, 8.40 mmol, 1.20 equiv.) dropwise at 0 °C. The reaction was stirred at 0 °C for 1 h. Then the mixture was warmed to room temperature and stirred for another 0.5 h.

Preparation of sulfinamidine

Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.23 g, 7.00 mmol, 1.00 equiv.), THF (14.0 mL), LiHMDS solution (7.00 mL, 1.00 M in THF, 7.00 mmol, 1.00 equiv.), TMSCl (0.89 mL, 7.00 mmol, 1.0 equiv.), 3-pyridylmagnesium chloride lithium chloride complex solution (8.40 mmol, 1.20 equiv.), CH_2Cl_2 (35.0 mL), Et_3N (1.17 mL, 8.40 mmol, 1.20 equiv.) and NsCl (1.71 g, 7.70 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 5:1 to 1:1 to 1:2) afforded *sulfinamidine* **3j** as a white solid (2.31 g, 5.27 mmol, 75%).

mp 114-116 °C;

R_f 0.26 (CH_2Cl_2/ethyl acetate, 1:1);

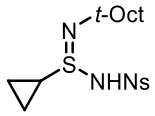
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.76 (s, 1H), 8.67 (d, *J* = 4.8 Hz, 1H), 8.23 (d, *J* = 8.8 Hz, 2H), 7.98 (d, *J* = 8.8 Hz, 2H), 7.97-7.93 (m, 1H), 7.38 (dd, *J* = 8.3, 4.8 Hz, 1H), 4.82 (s, 1H), 1.70 (d, *J* = 15.0 Hz, 1H), 1.65 (d, *J* = 15.0 Hz, 1H), 1.52 (s, 3H), 1.48 (s, 3H), 1.00 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 152.4, 149.9, 149.3, 148.1, 135.3, 135.1, 127.3, 124.2, 124.1, 61.0, 55.6, 31.8, 31.7, 30.7, 29.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1526, 1349, 1289, 1145, 1087, 974, 731, 616;

HRMS (ESI^+) calcd. for $C_{19}H_{27}N_4O_4S_2^+$ $[M+H]^+$: 439.1368, found: 439.1469.

_N_-(_S_-Cyclopropyl-_N_-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3k)



Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.21 g, 6.91 mmol, 1.00 equiv.), THF (13.8 mL), LiHMDS solution (6.91 mL, 1.00 M in THF, 6.91 mmol, 1.00 equiv.), TMSCl (0.88 mL, 6.91 mmol, 1.00 equiv.), cyclopropylmagnesium bromide solution (9.87 mL, 0.84 M in 2-methyltetrahydrofuran, 8.29 mmol, 1.20 equiv.), CH_2Cl_2 (34.5 mL), Et_3N (1.16 mL, 8.29 mmol, 1.20 equiv.) and NsCl (1.68 g, 7.59 mmol, 1.10 equiv.). Purification by flash column

chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfinamidine* **3k** as a white solid (2.32 g, 5.79 mmol, 84%).

mp 122-124 °C;

R_f 0.44 (petrol/ethyl acetate, 1:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.27 (d, *J* = 8.9 Hz, 2H), 8.03 (d, *J* = 8.9 Hz, 2H), 4.10 (s, 1H), 2.50 (tt, *J* = 7.8, 4.7 Hz, 1H), 1.57 (d, *J* = 15.0 Hz, 1H), 1.52 (d, *J* = 15.0 Hz, 1H), 1.39 (s, 3H), 1.35 (s, 3H), 1.28-1.20 (m, 1H), 0.98 (s, 9H), 0.92-0.77 (m, 2H), 0.63-0.55 (m, 1H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.8, 149.2, 127.4, 124.1, 59.6, 55.4, 31.9, 31.7, 31.1, 30.9, 28.9, 4.6, 1.7;

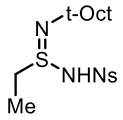
Notes:

1. For *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom;
2. For 2 secondary carbons in cyclopropane ring, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom;

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1526, 1349, 1285, 1142, 1089, 981, 855, 731, 616;

HRMS (ESI^+) calcd. for $C_{17}H_{28}N_3O_4S_2^+$ $[M+H]^+$: 402.1516, found: 402.1514.

N-(*S*-Ethyl-*N*-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3l)



Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.33 g, 7.62 mmol, 1.00 equiv.), THF (15.2 mL), LiHMDS solution (7.62 mL, 1.00 M in THF, 7.62 mmol, 1.00 equiv.), TMSCl (0.97 mL, 7.62 mmol, 1.00 equiv.), ethylmagnesium bromide solution (9.62 mL, 0.95 M in THF, 9.14 mmol, 1.20 equiv.), CH_2Cl_2 (38.1 mL), Et_3N (1.28 mL, 9.14 mmol, 1.20 equiv.) and NsCl (1.86 g, 8.38 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 20:1 to 10:1 to 5:1) afforded *sulfinamidine* **3l** as a white solid (1.80 g, 4.63 mmol, 61%).

mp 122-124 °C;

R_f 0.50 (CH_2Cl_2/ethyl acetate, 4:1);

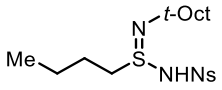
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.27 (d, J = 8.9 Hz, 2H), 8.05 (d, J = 8.9 Hz, 2H), 4.41 (s, 1H), 3.15 (q, J = 7.4 Hz, 2H), 1.58 (d, J = 14.9 Hz, 1H), 1.53 (d, J = 14.9 Hz, 1H), 1.39 (s, 3H), 1.36 (s, 3H), 1.15 (t, J = 7.4 Hz, 3H), 0.97 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.7, 149.3, 127.3, 124.1, 59.8, 55.6, 48.8, 31.8, 31.7, 31.0, 28.8, 8.8 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH₃)₂***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) =1527, 1349, 1285, 1142, 1089, 979, 855, 744, 615;

HRMS (ESI^+) calcd. for $C_{16}H_{28}N_3O_4S_2^+$ $[M+H]^+$: 390.1516, found: 390.1518.

N-(S-Butyl-N-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3m)



Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.23 g, 7.00 mmol, 1.00 equiv.), THF (14.0 mL), LiHMDS solution (7.00 mL, 1.00 M in THF, 7.00 mmol, 1.00 equiv.), TMSCl (0.89 mL, 7.00 mmol, 1.00 equiv.), butylmagnesium chloride solution (4.29 mL, 1.96 M in THF, 8.40 mmol, 1.20 equiv.), CH_2Cl_2 (35.0 mL), Et_3N (1.17 mL, 8.40 mmol, 1.20 equiv.) and NsCl (1.71 g, 7.70 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 25:1 to 10:1) afforded *sulfinamidine* **3m** as a white solid (2.11 g, 5.06 mmol, 72%).

mp 122-124 °C;

R_f 0.46 (CH_2Cl_2/ethyl acetate, 9:1);

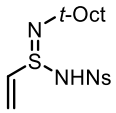
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.28 (d, J = 8.9 Hz, 2H), 8.05 (d, J = 8.9 Hz, 2H), 4.33 (s, 1H), 3.19-3.07 (m, 2H), 1.58 (d, J = 14.9 Hz, 1H), 1.53 (d, J = 14.9 Hz, 1H), 1.53-1.45 (m, 2H), 1.39 (s, 3H), 1.37 (s, 3H), 1.36-1.29 (m, 2H), 0.98 (s, 9H), 0.82 (t, J = 7.3 Hz, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.8, 149.3, 127.3, 124.1, 59.9, 55.7, 54.6, 31.8, 31.7, 31.0, 28.9, 25.9, 21.4, 13.6 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) =1524, 1346, 1290, 1145, 1088, 955, 919, 854, 770;

HRMS (ESI^+) calcd. for $C_{18}H_{31}N_3O_4S_2Na^+$ $[M+Na]^+$: 440.1648, found: 440.1649.

4-Nitro-*N*-(*N*-(2,4,4-trimethylpentan-2-yl)-*S*-vinylsulfinimidoyl)benzenesulfonamide (3n)



Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (1.31 g, 7.50 mmol, 1.00 equiv.), THF (15.0 mL), LiHMDS solution (7.50 mL, 1.00 M in THF, 7.50 mmol, 1.00 equiv.), TMSCl (0.95 mL, 7.50 mmol, 1.00 equiv.), vinylmagnesium bromide solution (10.10 mL, 0.89 M in THF, 9.00 mmol, 1.20 equiv.), CH_2Cl_2 (37.5 mL), Et_3N (1.25 mL, 9.00 mmol, 1.20 equiv.) and NsCl (1.83 g, 8.25 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 20:1 to 10:1 to 5:1) afforded *sulfinamidine* **3n** as a white solid (2.04 g, 5.27 mmol, 70%).

mp 92-94 °C;

R$_f$ 0.30 (CH_2Cl_2/ethyl acetate, 10:1);

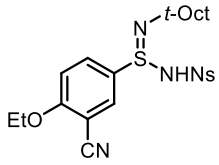
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.27 (d, J = 8.9 Hz, 2H), 8.03 (d, J = 8.9 Hz, 2H), 6.50 (dd, J = 16.0, 9.2 Hz, 1H), 5.99 (dd, J = 16.0, 1.4 Hz, 1H), 5.90 (dd, J = 9.2, 1.4 Hz, 1H), 4.31 (s, 1H), 1.62 (d, J = 15.0 Hz, 1H), 1.54 (d, J = 15.0 Hz, 1H), 1.43 (s, 3H), 1.39 (s, 3H), 0.98 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.4, 149.3, 135.3, 127.3, 125.8, 124.1, 60.1, 55.3, 31.8, 31.7, 31.0, 29.1 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1526, 1349, 1287, 1143, 1088, 979, 855, 618;

HRMS (ESI^+) calcd. for $C_{16}H_{26}N_3O_4S_2^+$ $[M+H]^+$: 388.1359, found: 388.1361.

***N*-(*S*-(3-Cyano-4-ethoxyphenyl)-*N*-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)-4-nitrobenzenesulfonamide (3o)**



Preparation of organometallic reagent

(3-Cyano-4-ethoxyphenyl)lithium solution was prepared according to the following procedure. To a solution of 5-bromo-2-ethoxybenzonitrile (9.08 g, 40.30 mmol, 1.50 equiv.) in anhydrous THF (40.3 mL) in an oven-dried 250 mL round-bottom flask was added *n*-butyllithium solution (16.67 mL, 2.42 M in hexanes, 40.30 mmol, 1.50 equiv.) dropwise at -78 °C. The reaction was stirred at the same temperature for 20 min.

Preparation of sulfinamidine

Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (4.73 g, 27.00 mmol, 1.00 equiv.), THF (27.0 mL), LiHMDS solution (27.00 mL, 1.00 M in THF, 27.00 mmol, 1.00 equiv.), TMSCl (3.43 mL, 27.00 mmol, 1.00 equiv.), (3-cyano-4-ethoxyphenyl)lithium solution (40.30 mmol, 1.50 equiv.), CH_2Cl_2 (135.0 mL), Et_3N (6.02 mL, 43.20 mmol, 1.60 equiv.) and NsCl (8.98 g, 40.50 mmol, 1.50 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 20:1 to 10:1) afforded *sulfinamidine* **3o** as a white solid (7.11 g, 14.05 mmol, 52%).

mp 128-130 °C;

R_f 0.50 (CH_2Cl_2/ethyl acetate, 9:1);

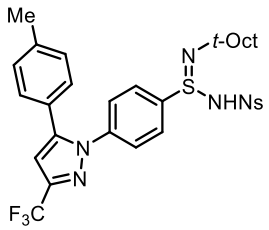
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.25 (d, J = 8.9 Hz, 2H), 7.99 (d, J = 8.9 Hz, 2H), 7.78-7.73 (m, 2H), 6.99 (d, J = 8.9 Hz, 1H), 4.54 (s, 1H), 4.18 (qd, J = 7.0, 1.0 Hz, 2H), 1.67 (d, J = 15.0 Hz, 1H), 1.63 (d, J = 15.0 Hz, 1H), 1.50 (s, 3H), 1.49 (t, J = 7.0 Hz, 3H), 1.46 (s, 3H), 1.00 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 163.1, 150.1, 149.4, 133.2, 132.8, 129.9, 127.4, 124.2, 114.8, 113.0, 103.6, 65.9, 60.8, 55.7, 31.84, 31.76, 30.7, 29.4, 14.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1473, 1383, 1349, 1286, 1252, 1147, 1087, 956;

HRMS (ESI$^+$) calcd. for $C_{23}H_{31}N_4O_5S_2^+$ $[M+H]^+$: 507.1730, found: 507.1729.

4-Nitro-*N*-(*S*-(4-(5-(p-tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)phenyl)-*N*-(2,4,4-trimethylpentan-2-yl)sulfinimidoyl)benzenesulfonamide (3p)



Preparation of organometallic reagent

(4-(5-(*p*-Tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)phenyl)lithium solution was prepared according to the following procedure. To a solution of 1-(4-bromophenyl)-5-(*p*-tolyl)-3-(trifluoromethyl)-1*H*-pyrazole (2.42 g, 6.37 mmol, 1.20 equiv.) in anhydrous THF (12.7 mL) in an oven-dried 100 mL round-bottom flask was added *n*-butyllithium solution (2.55 mL, 2.50 M in hexanes, 6.37 mmol, 1.20 equiv.) dropwise at -78 °C. The reaction was stirred at the same temperature for 40 min.

Preparation of sulfinamidine

Prepared according to **General Procedure A** using *N*-sulfinyl-*tert*-octylamine (0.91 g, 5.22 mmol, 1.00 equiv.), THF (10.4 mL), LiHMDS solution (5.22 mL, 1.00 M in THF, 5.22 mmol, 1.00 equiv.), TMSCl (0.66 mL, 5.22 mmol, 1.00 equiv.), (4-(5-(*p*-tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)phenyl)lithium solution (6.37 mmol, 1.20 equiv.), CH_2Cl_2 (26.1 mL), Et_3N (0.89 mL, 6.37 mmol, 1.20 equiv.) and NsCl (1.27 g, 5.74 mmol, 1.10 equiv.). Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 50:1 to 30:1 to 20:1) afforded *sulfinamidine* **3p** as a white solid (3.28 g, 4.96 mmol, 95%).

mp 95-97 °C;

R$_f$ 0.45 (CH_2Cl_2/ethyl acetate, 30:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.22 (d, J = 8.8 Hz, 2H), 7.99 (d, J = 8.8 Hz, 2H), 7.61 (d, J = 8.9 Hz, 2H), 7.40 (d, J = 8.9 Hz, 2H), 7.15 (d, J = 8.0 Hz, 2H), 7.07 (d, J = 8.0 Hz, 2H), 6.71 (s, 1H), 4.46 (s, 1H), 2.37 (s, 3H), 1.66 (d, J = 15.0 Hz, 1H), 1.62 (d, J = 15.0 Hz, 1H), 1.50 (s, 3H), 1.44 (s, 3H), 0.98 (s, 9H);

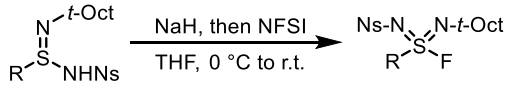
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.1, 149.3, 145.3, 144.2 (q, J = 38.5 Hz), 142.2, 140.0, 137.7, 129.8, 128.8, 128.0, 127.4, 125.78, 125.75, 124.1, 121.10 (q, J = 269.3 Hz), 106.5, 60.8, 55.8, 31.8, 31.7, 30.7, 29.2, 21.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -62.4 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1236, 1139, 1088, 969, 855, 732, 614;

HRMS (ESI^+) calcd. for $C_{31}H_{35}F_3N_5O_4S_2^+$ $[M+H]^+$: 662.2077, found: 662.2071.

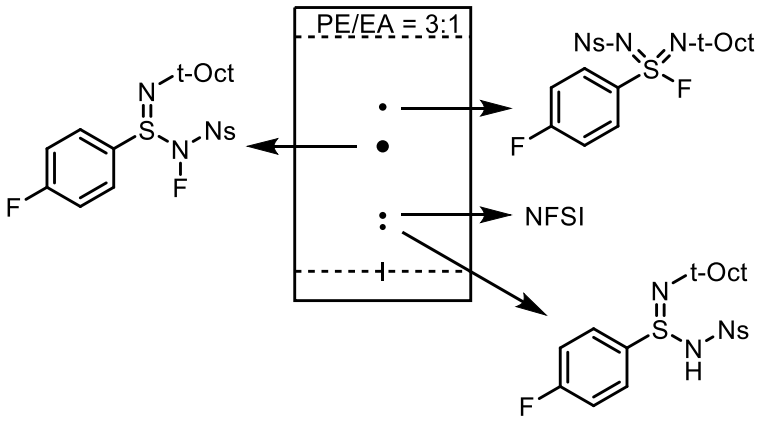
2.2.3 General Procedure B for Sulfondiimidoyl Fluoride Synthesis



An oven-dried round-bottom flask was charged with sulfinamidine (1.00 equiv.) and NaH (60 % dispersion in mineral oil, 1.10 equiv.) at 0 °C and was purged with nitrogen gas. Anhydrous THF (0.5 M) was added. The reaction was stirred at 0 °C for 5 min before being warmed to room temperature and stirred for another 25 min. NFSI (1.50 equiv.) was then added under a positive pressure of nitrogen and the reaction was stirred at room temperature for 30 min before being quenched with sat. aq. NaCl solution. Ethyl acetate was added and the organic layer was separated. The aqueous layer was further extracted with ethyl acetate twice. The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure to give a crude solid. Diethyl ether was added to the crude solid. The resulting suspension was shaken well before being filtered. The white filter cake was washed with diethyl ether and CH_2Cl_2. The combined filtrate was concentrated under reduced pressure to give a crude product containing a mixture of *N*-fluorinated product and *S*-fluorinated product. The crude mixture was allowed to stand at room temperature (open to air) for 1-8 days until all the *N*-fluorinated product had isomerized to the desired *S*-fluorinated product (as determined by TLC and ^{19}F NMR). The crude product was then purified by flash column chromatography to afford the sulfondiimidoyl fluoride.

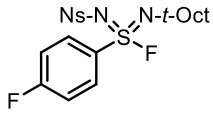
Notes:

1. The time taken for the *N*-fluorinated compound to isomerize into the *S*-fluorinated compound varies from substrate to substrate. ^{19}F NMR can be used to monitor this isomerization and determine when it is complete. The chemical shifts of the fluorine atoms for *N*-fluorinated compounds in the ^{19}F NMR are present at approximately -70 ppm and the chemical shifts of the fluorine atoms for *S*-fluorinated compounds in the ^{19}F NMR are present at approximately 80 ppm. When monitoring by TLC, the *N*-fluorinated compound is usually more polar than *S*-fluorinated compound (in the eluent system of petrol and ethyl acetate).



2. Even for different batches of the same substrate, the time taken for the *N*-fluorinated compound to isomerize into the *S*-fluorinated compound is not identical. It is recommended to monitor the isomerization every 12 h by ^{19}F NMR or TLC.
3. Sulfondiimidoyl fluorides decompose gradually when stored in $CDCl_3$. As such, it is recommended to remove the $CDCl_3$ or other deuterated solvent immediately after the NMR experiments for longer term storage. Storing them in pure form typically reduces their decomposition rate.
4. Sulfondiimidoyl fluorides containing electron-withdrawing substituents on carbon e.g. **4d, 4e, 4h, 4j** and **4o** can be susceptible to hydrolysis when stored at room temperature. For this reason, we suggest purification of all sulfondiimidoyl fluorides should be carried out as soon as possible upon the completion of isomerization. We also recommend using purified sulfondiimidoyl fluorides in the next amination step immediately in order to maximise yield.
5. The *in-situ* generated sulfinamidine salt forms a viscous slurry in the reaction flask. When NFSI (solid) is added, the stirring is often difficult and some solid was found to stick to the upper part of the wall of the round-bottom flask, which led to insufficient reaction of the two reagents and reduced yield. When this happens, it is recommended to add additional anhydrous THF (sulfinamidine conc. 1.0 M) to flush the adhered solids from the wall to the bottom of round-bottom flask, and the addition of THF will not lead to a decrease in yield.
6. Addition of 15-crown-5 (1.1 equiv.) to the reaction mixture at 0 °C after the addition of the anhydrous THF prevents the formation of the slurry, and the *in-situ* generated sulfinamidine salt dissolves to form a clear solution. Although the improved stirring gave a slight improvement of yield (70%), this additive was not used in any of the scope reactions.

4-Fluoro-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4a)



An oven-dried 50 mL round-bottom flask was charged with sulfinamidine **3a** (2.20 g, 4.84 mmol, 1.00 equiv.) and NaH (213 mg, 60 % dispersion in mineral oil, 5.32 mmol, 1.10 equiv.) at 0 °C and was purged with nitrogen gas. Anhydrous THF (9.70 mL) was added. The reaction was stirred at 0 °C for 5 min before being warmed to room temperature and stirred for another 25 min. NFSI (2.29 g, 7.26 mmol, 1.50 equiv.) was then added under a positive pressure of nitrogen and the reaction was stirred at room temperature for 30 min before being quenched with sat. aq. NaCl solution (250 mL). Ethyl acetate (150 mL) was added and the organic layer was separated. The aqueous layer was further extracted with ethyl acetate (2 × 60 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure to give a crude solid. Diethyl ether (100 mL) was added to the crude solid and the resulting suspension was shaken well before being filtered. The white filter cake was washed with diethyl ether (120 mL) and CH_2Cl_2 (20 mL). The combined filtrate was concentrated under reduced pressure to give a crude product containing a mixture of *N*-fluorinated product and *S*-fluorinated product. The crude mixture was allowed to stand at room temperature (open to air) for 16-20 h until all the *N*-fluorinated product had isomerized to the desired *S*-fluorinated product (as determined by TLC and ^{19}F NMR). The crude product was then purified by flash column chromatography (petrol/ethyl acetate, 4:1) to afford *sulfondiimidoyl fluoride* **4a** a pale-yellow solid (1.56 g, 3.30 mmol, 68%).

mp 57-59 °C;

R_f 0.59 (petrol/ethyl acetate, 6:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.32 (d, J = 8.9 Hz, 2H), 8.06 (d, J = 8.9 Hz, 2H), 8.04-7.98 (m, 2H), 7.26-7.19 (m, 2H), 1.67 (d, J = 14.7 Hz, 1H), 1.52 (d, J = 14.7 Hz, 1H), 1.48 (s, 3H), 1.43 (s, 3H), 0.96 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.1 (d, J = 258.8 Hz), 150.0, 148.3, 134.4 (dd, J = 25.1, 3.3 Hz), 130.6 (d, J = 9.8 Hz), 128.1, 124.2, 116.9 (d, J = 23.1 Hz), 63.5 (d, J = 4.6 Hz), 56.5 (d, J = 3.2 Hz), 31.84, 31.79 (d, J = 2.7 Hz), 31.52, 31.45 (d, J = 6.6 Hz) (note: for *gem*-dimethyl carbons in

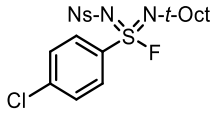
tert-octyl group, NC***(CH₃)₂***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 86.5 (s), -101.4 (tt, J = 7.8, 4.7 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1532, 1492, 1348, 1240, 1163, 1089, 1075;

HRMS (ESI^+) calcd. for $C_{20}H_{25}F_2N_3O_4S_2Na^+$ $[M+Na]^+$: 496.1147, found: 496.1146.

4-Chloro-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4b)



Prepared according to **General Procedure B** using sulfinamidine **3b** (707 mg, 1.50 mmol, 1.00 equiv.), THF (3.00 mL), NaH (66 mg, 60 % dispersion in mineral oil, 1.65 mmol, 1.10 equiv.) and NFSI (709 mg, 2.25 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 16 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1) afforded *sulfondiimidoyl fluoride* **4b** as a white solid (520 mg, 1.06 mmol, 71%).

mp 66-68 °C;

R_f 0.55 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.32 (d, J = 8.9 Hz, 2H), 8.06 (d, J = 8.9 Hz, 2H), 7.92 (d, J = 8.9 Hz, 2H), 7.52 (d, J = 8.9 Hz, 2H), 1.67 (d, J = 14.7 Hz, 1H), 1.53 (d, J = 14.7 Hz, 1H), 1.48 (s, 3H), 1.44 (s, 3H), 0.97 (s, 9H);

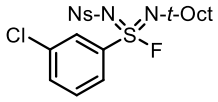
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.0, 148.2, 141.4, 136.9 (d, J = 25.3 Hz), 129.8, 129.0, 128.1, 124.2, 63.5 (d, J = 4.4 Hz), 56.5 (d, J = 3.4 Hz), 31.83, 31.81 (d, J = 2.5 Hz), 31.51, 31.46 (d, J = 5.9 Hz) (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH₃)₂***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 86.0 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1347, 1309, 1162, 1108, 1087, 1072, 1010, 745, 610;

HRMS (ESI$^+$) calcd. for $C_{20}H_{25}ClFN_3O_4S_2Na^+$ [M+Na]$^+$: 512.0851, found: 512.0857.

3-Chloro-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4c)



Prepared according to **General Procedure B** using sulfinamidine **3c** (471 mg, 1.00 mmol, 1.00 equiv.), THF (2.00 mL), NaH (44 mg, 60 % dispersion in mineral oil, 1.10 mmol, 1.10 equiv.) and NFSI (473 mg, 1,50 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 24 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1) afforded *sulfondiimidoyl fluoride* **4c** as a pale-yellow oil (313 mg, 0.64 mmol, 64%).

R$_f$ 0.70 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.29 (d, J = 8.9 Hz, 2H), 8.02 (d, J = 8.9 Hz, 2H), 7.87 (ddd, J = 8.1, 2.0, 1.0 Hz, 1H), 7.81 (t, J = 2.0 Hz, 1H), 7.61 (ddd, J = 8.1, 2.0, 1.0 Hz, 1H), 7.49 (t, J = 8.1 Hz, 1H), 1.68 (d, J = 14.7 Hz, 1H), 1.54 (d, J = 14.7 Hz, 1H), 1.51 (s, 3H), 1.47 (s, 3H), 0.97 (s, 9H);

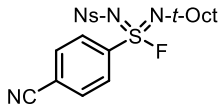
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.0, 148.0, 139.7 (d, J = 25.3 Hz), 135.5, 134.5, 130.7, 128.1, 127.4, 125.7, 124.2, 63.7 (d, J = 4.6 Hz), 56.4 (d, J = 3.3 Hz), 31.84 (d, J = 2.8 Hz), 31.78, 31.5, 31.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 85.8 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1347, 1310. 1163, 1131, 1088, 1071, 672, 616;

HRMS (ESI$^+$) calcd. for $C_{20}H_{25}ClFN_3O_4S_2Na^+$ [M+Na]$^+$: 512.0851, found: 512.0854.

4-Cyanophenyl-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4d)



Prepared according to **General Procedure B** using sulfinamidine **3d** (693 mg, 1.50 mmol, 1.00 equiv.), THF (3.00 mL), NaH (66 mg, 60 % dispersion in mineral oil, 1.65 mmol, 1.10 equiv.) and NFSI (709 mg, 2.25 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 24 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:1) afforded *sulfondiimidoyl fluoride* **4d** as a colourless oil (325 mg, 0.68 mmol, 45%).

R_f 0.50 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.34 (d, J = 8.8 Hz, 2H), 8.14 (d, J = 8.7 Hz, 2H), 8.08 (d, J = 8.8 Hz, 2H), 7.87 (d, J = 8.7 Hz, 2H), 1.66 (d, J = 14.7 Hz, 1H), 1.52 (d, J = 14.7 Hz, 1H), 1.47 (s, 3H), 1.43 (s, 3H), 0.95 (s, 9H);

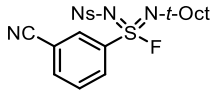
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.1, 147.9, 142.5 (d, J = 26.3 Hz), 133.2, 128.2, 128.1, 124.3, 118.1, 116.8, 64.0 (d, J = 4.6 Hz), 56.3 (d, J = 3.3 Hz), 31.8, 31.78, 31.5, 31.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 86.3 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1532, 1350, 1303, 1164, 1133, 1107, 1089, 1071;

HRMS (ESI^+) calcd. for $C_{21}H_{25}FN_4O_4S_2Na^+$ $[M+Na]^+$: 503.1193, found: 503.1194.

3-Cyanophenyl-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4e)



Prepared according to **General Procedure B** using sulfinamidine **3e** (693 mg, 1.50 mmol,

1.00 equiv.), THF (3.00 mL), NaH (66 mg, 60 % dispersion in mineral oil, 1.65 mmol, 1.10 equiv.) and NFSI (709 mg, 2.25 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 24 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:1) afforded *sulfondiimidoyl fluoride* **4e** as a colourless oil (359 mg, 0.75 mmol, 50%).

R$_f$ 0.55 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.33 (d, J = 8.9 Hz, 2H), 8.27-8.21 (m, 2H), 8.07 (d, J = 8.9 Hz, 2H), 7.96 (dt, J = 7.8, 1.3 Hz, 1H), 7.73 (t, J = 7.8 Hz, 1H), 1.67 (d, J = 14.8 Hz, 1H), 1.54 (d, J = 14.8 Hz, 1H), 1.48 (s, 3H), 1.44 (s, 3H), 0.95 (s, 9H);

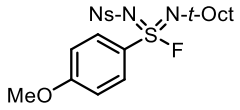
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.1, 147.8, 140.1 (d, J = 26.9 Hz), 137.3, 131.3, 131.1, 130.6, 128.1, 124.3, 116.6, 114.2, 64.0 (d, J = 4.6 Hz), 56.3 (d, J = 3.3 Hz), 31.8, 31.7, 31.5, 31.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 86.7 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1532, 1349, 1306, 1164, 1109, 1087, 1073;

HRMS (ESI^+) calcd. for $C_{21}H_{25}FN_4O_4S_2Na^+$ $[M+Na]^+$: 503.1193, found: 503.1188.

4-Methoxyphenyl-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4f)



Prepared according to **General Procedure B** using sulfinamidine **3f** (467 mg, 1.00 mmol, 1.00 equiv.), THF (2.00 mL), NaH (44 mg, 60 % dispersion in mineral oil, 1.10 mmol, 1.10 equiv.) and NFSI (473 mg, 1.50 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 24 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:1) afforded xx *sulfondiimidoyl fluoride* **4f** a colourless oil (325 mg, 0.67 mmol, 67%).

R$_f$ 0.54 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.25 (d, *J* = 8.7 Hz, 2H), 8.00 (d, *J* = 8.7 Hz, 2H), 7.84 (d, *J* = 9.0 Hz, 2H), 6.93 (d, *J* = 9.0 Hz, 2H), 3.83 (s, 3H), 1.65 (d, *J* = 14.8 Hz, 1H), 1.51 (d, *J* = 14.8 Hz, 1H), 1.48 (s, 3H), 1.43 (s, 3H), 0.95 (s, 9H);

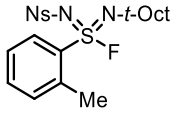
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.2, 149.7, 148.4, 129.9, 129.2 (d, *J* = 24.0 Hz), 128.0, 124.0, 114.5, 62.9 (d, *J* = 4.4 Hz), 56.4 (d, *J* = 3.2 Hz), 55.9, 31.72, 31.69 (d, *J* = 2.7 Hz), 31.5, 31.3 (d, *J* = 6.2 Hz) (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 86.1 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1349, 1311, 1266, 1162, 1104, 1089;

HRMS (ESI^+) calcd. for $C_{21}H_{28}FN_3O_5S_2Na^+$ $[M+Na]^+$: 508.1347, found: 508.1353.

_o_-Tolyl-_N_-((4-nitrophenyl)sulfonyl)-_N_-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4g)



Prepared according to **General Procedure B** using sulfinamidine **3g** (451 mg, 1.00 mmol, 1.00 equiv.), THF (2.00 mL), NaH (44 mg, 60 % dispersion in mineral oil, 1.10 mmol, 1.10 equiv.) and NFSI (473 mg, 1.50 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 48 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:1) afforded *sulfondiimidoyl fluoride* **4g** a white solid (235 mg, 0.50 mmol, 50%).

mp 86-88 °C;

R$_f$ 0.63 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.26 (d, *J* = 8.9 Hz, 2H), 7.98 (d, *J* = 8.9 Hz, 2H), 7.98-7.95 (m, 1H), 7.53 (td, *J* = 7.5, 1.3 Hz, 1H), 7.38 (t, *J* = 7.5 Hz, 1H), 7.29 (d, *J* = 7.5 Hz, 1H), 2.56 (s, 3H), 1.59 (d, *J* = 14.6 Hz, 1H), 1.50 (d, *J* = 14.6 Hz, 1H), 1.47 (s, 3H), 1.45 (s, 3H), 0.89 (s, 9H);

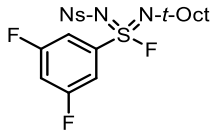
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.8, 148.1, 137.6, 137.3 (d, J = 19.5 Hz), 134.2, 133.0 (d, J = 1.8 Hz), 128.2 (d, J = 2.4 Hz), 128.1, 126.6, 124.0, 63.5 (d, J = 4.6 Hz), 56.5 (d, J = 3.0 Hz), 31.7, 31.5 (d, J = 3.1 Hz), 31.4, 31.1 (d, J = 6.6 Hz), 20.1 (d, J = 2.3 Hz) (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 81.2 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1349, 1327, 1306, 1164, 1147, 1086, 1059, 686, 620;

HRMS (ESI^+) calcd. for $C_{21}H_{28}FN_3O_4S_2Na^+$ $[M+Na]^+$: 492.1397, found: 492.1389.

3,5-Difluorophenyl-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4h)



Prepared according to **General Procedure B** using sulfinamidine **3h** (710 mg, 1.50 mmol, 1.00 equiv.), THF (3.00 mL), NaH (66 mg, 60 % dispersion in mineral oil, 1.65 mmol, 1.10 equiv.) and NFSI (709 mg, 2.25 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 24 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1) afforded *sulfondiimidoyl fluoride* **4h** as a white solid (373 mg, 0.76 mmol, 51%).

mp 50-52 °C;

R_f 0.70 (petrol/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.34 (d, J = 8.9 Hz, 2H), 8.08 (d, J = 8.9 Hz, 2H), 7.56-7.51 (m, 2H), 7.13 (tt, J = 8.2, 2.3 Hz, 1H), 1.68 (d, J = 14.7 Hz, 1H), 1.54 (d, J = 14.7 Hz, 1H), 1.49 (s, 3H), 1.45 (s, 3H), 0.97 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 162.6 (dd, J = 256.0, 11.8 Hz), 150.1, 147.9, 141.2 (dt, J = 28.4, 9.6 Hz), 128.1, 124.3, 111.7-111.3 (second-order multiplet), 110.2 (t, J = 24.9 Hz), 64.0 (d,

J = 4.6 Hz), 56.3 (d, *J* = 3.4 Hz), 31.82, 31.80, 31.46 (d, *J* = 6.1 Hz), 31.45 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH₃)₂***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

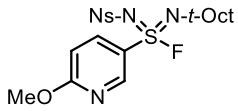
^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 87.12 (s), -103.8- -103.9 (second-order multiplet);

The second-order multiplet in the ^{13}C and ^{19}F NMR spectra arise due to virtual coupling;

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1604, 1533, 1349, 1299, 1166, 1131, 1106, 1086;

HRMS (ESI^+) calcd. for $C_{20}H_{24}F_3N_3O_4S_2Na^+$ $[M+Na]^+$: 514.1053, found: 514.1053.

6-Methoxy-*N*-(4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)pyridine-3-sulfondiimidoyl fluoride (4i)



Prepared according to **General Procedure B** using sulfinamidine **3i** (468 mg, 1.00 mmol, 1.00 equiv.), THF (2.00 mL), NaH (44 mg, 60 % dispersion in mineral oil, 1.10 mmol, 1.10 equiv.) and NFSI (473 mg, 1.50 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 24 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:1) afforded *sulfondiimidoyl fluoride* **4i** as a white solid (291 mg, 0.60 mmol, 60%).

mp 70-72 °C;

R_f 0.50 (petrol/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.69 (d, *J* = 2.7 Hz, 1H), 8.29 (d, *J* = 9.0 Hz, 2H), 8.08-8.05 (m, 1H), 8.04 (d, *J* = 9.0 Hz, 2H), 6.81 (dd, *J* = 9.0, 0.6 Hz, 1H), 3.98 (s, 3H), 1.65 (d, *J* = 14.7 Hz, 1H), 1.50 (d, *J* = 14.7 Hz, 1H), 1.47 (s, 3H), 1.42 (s, 3H), 0.95 (s, 9H);

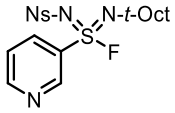
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 167.2, 149.9, 148.2, 148.1, 137.3, 128.1, 127.7 (d, *J* = 24.8 Hz), 124.1, 111.6, 63.4 (d, *J* = 4.4 Hz), 56.4 (d, *J* = 3.1 Hz), 54.8, 31.8, 31.7 (d, *J* = 2.6 Hz), 31.5, 31.4 (d, *J* = 6.3 Hz) (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH₃)₂***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 88.7 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1588, 1532, 1484, 1381, 1348, 1310, 1288, 1163, 1086, 607;

HRMS (ESI^+) calcd. for $C_{20}H_{27}FN_4O_5S_2Na^+$ $[M+Na]^+$: 509.1299, found: 509.1307.

_N_-((4-Nitrophenyl)sulfonyl)-_N_-(2,4,4-trimethylpentan-2-yl)pyridine-3-sulfondiimidoyl fluoride (4j)



Prepared according to **General Procedure B** using sulfinamidine **3j** (657 mg, 1.50 mmol, 1.00 equiv.), THF (3.00 mL), NaH (66 mg, 60 % dispersion in mineral oil, 1.65 mmol, 1.10 equiv.) and NFSI (709 mg, 2.25 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 72 h for the completion of isomerization. Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 25:1 to 10:1) afforded *sulfondiimidoyl fluoride* **4j** as a colourless oil (275 mg, 0.60 mmol, 40%).

R_f 0.58 (CH_2Cl_2/ethyl acetate, 20:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 9.10 (dd, *J* = 2.5, 0.8 Hz, 1H), 8.84 (dd, *J* = 4.9, 1.5 Hz, 1H), 8.31-8.27 (m,1 H), 8.29 (d, *J* = 9.0 Hz, 2H), 8.03 (d, *J* = 9.0 Hz, 2H), 7.50 (ddd, *J* = 8.3, 4.9, 0.8 Hz, 1H), 1.66 (d, *J* = 14.7 Hz, 1H), 1.52 (d, *J* = 14.7 Hz, 1H), 1.48 (s, 3H), 1.43 (s, 3H), 0.94 (s, 9H);

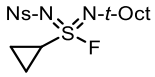
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 154.5, 150.0, 148.1, 147.9, 135.5 (d, *J* = 24.9 Hz), 135.1, 128.0, 124.2, 123.8, 63.8 (d, *J* = 4.5 Hz), 56.3 (d, *J* = 3.2 Hz), 31.8, 31.7, 31.44, 31.39 (note: for *gem*-dimethyl carbons in *tert*-octyl group, $NC\boldsymbol{(CH_3)_2}CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 88.1 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1532, 1473, 1462, 1382, 1251, 1162, 1085, 954;

HRMS (ESI^+) calcd. for $C_{19}H_{25}FN_4O_4S_2Na^+$ $[M+Na]^+$: 479.1193, found: 479.1195.

***N*-((4-Nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)cyclopropanesulfondiimidoyl fluoride (4k)**



Prepared according to **General Procedure B** using sulfinamidine **3k** (401 mg, 1.00 mmol, 1.00 equiv.), THF (2.00 mL), NaH (44 mg, 60 % dispersion in mineral oil, 1.10 mmol, 1.10 equiv.) and NFSI (473 mg, 1.50 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 8 days for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:1) afforded *sulfondiimidoyl fluoride* **4k** as a colourless oil (390 mg, 0.93 mmol, 93%).

R$_f$ 0.63 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.34 (d, J = 8.9 Hz, 2H), 8.14 (d, J = 8.9 Hz, 2H), 3.50 (tq, J = 8.3, 4.3 Hz, 1H), 1.55-1.47 (m, 1H), 1.51 (d, J = 14.7 Hz, 1H), 1.43-1.36 (m, 1H), 1.39 (d, J = 14.7 Hz, 1H), 1.32 (s, 3H), 1.30-1.18 (m, 2H), 1.27 (s, 3H), 0.93 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.0, 148.7, 128.1, 124.2, 62.2 (d, J = 4.5 Hz), 56.5 (d, J = 2.5 Hz), 34.9 (d, J = 28.5 Hz), 31.7, 31.5, 31.4 (d, J = 2.7 Hz), 31.2 (d, J = 6.9 Hz), 8.2, 7.9 (d, J = 2.0 Hz);

Notes:

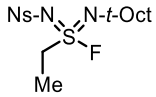
1. For *gem*-dimethyl carbons in *tert*-octyl group, $NC\boldsymbol{(CH_3)_2}CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom;
2. For 2 secondary carbons in cyclopropane ring, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 86.0 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1349, 1334, 1299, 1160, 1071, 735, 686, 615;

HRMS (ESI^+) calcd. for $C_{17}H_{26}FN_3O_4S_2Na^+$ $[M+Na]^+$: 442.1241, found: 442.1241.

***N*-((4-Nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)ethanesulfondiimidoyl fluoride (4l)**



Prepared according to **General Procedure B** using sulfinamidine **3l** (389 mg, 1.00 mmol, 1.00 equiv.), THF (2.00 mL), NaH (44 mg, 60 % dispersion in mineral oil, 1.10 mmol, 1.10 equiv.) and NFSI (473 mg, 1.50 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 12 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1) afforded *sulfondiimidoyl fluoride* **4l** as a white solid (286 mg, 0.70 mmol, 70%).

mp 80-82 °C;

R_f 0.52 (petrol/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.30 (d, J = 9.0 Hz, 2H), 8.08 (d, J = 9.0 Hz, 2H), 3.90-3.69 (m, 2H), 1.53-1.47 (m, 4H), 1.36 (d, J = 14.7 Hz, 1H), 1.31 (s, 3H), 1.23 (s, 3H), 0.90 (s, 9H);

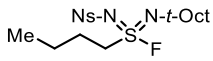
^{13}C NMR (101 MHz, $CDCl_3$): 149.8, 148.4, 128.0, 124.1, 62.1 (d, J = 4.7 Hz), 56.2 (d, J = 2.7 Hz), 52.5 (d, J = 17.0 Hz), 31.7, 31.39 (d, J = 2.7 Hz), 31.36, 31.1 (d, J = 6.8 Hz), 8.7 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 77.9 (t, J = 3.5 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1349, 1161, 1081, 1056, 739;

HRMS (ESI^+) calcd. for $C_{16}H_{26}FN_3O_4S_2Na^+$ $[M+Na]^+$: 430.1241, found: 430.1240.

***N*-((4-Nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)butanesulfondiimidoyl fluoride (4m)**



Prepared according to **General Procedure B** using sulfinamidine **3m** (626 mg, 1.50 mmol, 1.00 equiv.), THF (3.00 mL), NaH (66 mg, 60 % dispersion in mineral oil, 1.65 mmol, 1.10 equiv.) and NFSI (709 mg, 2.25 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-

fluorinated compound was left at room temperature for 6 days for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 7:1 to 5:1) afforded *sulfondiimidoyl fluoride* **4m** as a colourless oil (593 mg, 1.36 mmol, 91%).

R$_f$ 0.47 (petrol/ethyl acetate, 8:1);

^{1}H NMR (400 MHz, CD_3CN): δ (ppm) = 8.34 (d, J = 8.9 Hz, 2H), 8.11 (d, J = 8.9 Hz, 2H), 3.88 (dddd, J = 13.8, 9.0, 6.2, 2.5 Hz, 1H), 3.76 (dddd, J = 13.8, 9.0, 6.2, 4.0 Hz, 1H), 1.93-1.84 (m, 2H), 1.58 (d, J = 14.6 Hz, 1H), 1.53-1.42 (m, 3H), 1.36 (s, 3H), 1.30 (s, 3H), 0.97 (s, 9H), 0.94 (t, J = 7.4 Hz, 3H);

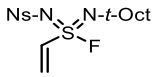
^{13}C NMR (101 MHz, CD_3CN): δ (ppm) = 151.2, 149.3, 128.9, 125.4, 62.9 (d, J = 4.9 Hz), 57.7 (d, J = 14.2 Hz), 56.8 (d, J = 3.1 Hz), 32.2, 31.8 (d, J = 3.1 Hz), 31.7, 31.5 (d, J = 6.8 Hz), 26.7, 21.5, 13.6 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, CD_3CN): δ (ppm) = 81.2 (t, J = 3.4 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1348, 1307, 1160, 1071, 742, 686, 614;

HRMS (ESI^+) calcd. for $C_{18}H_{30}FN_3O_4S_2Na^+$ $[M+Na]^+$: 458.1554, found: 458.1552.

_N_-((4-Nitrophenyl)sulfonyl)-_N_-(2,4,4-trimethylpentan-2-yl)ethenesulfondiimidoyl fluoride (4n)



Prepared according to **General Procedure B** using sulfinamidine **3n** (418 mg, 1.08 mmol, 1.00 equiv.), THF (3.60 mL), NaH (48 mg, 60 % dispersion in mineral oil, 1.20 mmol, 1.10 equiv.) and NFSI (510 mg, 1.62 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 24 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 3:1) afforded *sulfondiimidoyl fluoride* **4n** as a colourless oil (210 mg, 0.52 mmol, 48%).

R$_f$ 0.62 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.33 (d, *J* = 8.8 Hz, 2H), 8.11 (d, *J* = 8.8 Hz, 2H), 7.04 (ddd, *J* = 16.0, 9.6, 2.3 Hz, 1H), 6.55 (dd, *J* = 16.0, 1.5 Hz, 1H), 6.25 (ddd, *J* = 9.6, 4.5, 1.5 Hz, 1H), 1.59 (d, *J* = 14.7 Hz, 1H), 1.43 (d, *J* = 14.7 Hz, 1H), 1.37 (s, 3H), 1.32 (s, 3H), 0.93 (s, 9H);

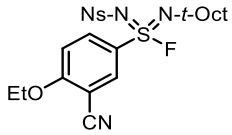
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.9, 148.3, 134.1 (d, *J* = 29.0 Hz), 130.3, 128.1, 124.2, 62.6 (d, *J* = 4.6 Hz), 56.2 (d, *J* = 3.1 Hz), 31.7, 31.6 (d, *J* = 2.7 Hz), 31.5 (d, *J* = 6.3 Hz), 31.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 86.5 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1348, 1312, 1161, 1082, 741, 616;

HRMS (ESI^+) calcd. for $C_{16}H_{24}FN_3O_4S_2Na^+$ $[M+Na]^+$: 428.1084, found: 428.1084.

3-Cyano-4-ethoxy-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4o)



Prepared according to **General Procedure B** using sulfinamidine **3o** (3.84 g, 7.58 mmol, 1.00 equiv.), THF (15.2 mL), NaH (334 mg, 60 % dispersion in mineral oil, 8.35 mmol, 1.10 equiv.) and NFSI (3.58 g, 11.37 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 20 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 2:1) afforded *sulfondiimidoyl fluoride* **4o** as a white solid (1.91 g, 3.65 mmol, 48%).

mp 120-122 °C;

R_f 0.58 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.32 (d, *J* = 8.9 Hz, 2H), 8.15 (dd, *J* = 9.1, 2.6 Hz, 1H), 8.11 (d, *J* = 2.6 Hz, 1H), 8.06 (d, *J* = 8.9 Hz, 2H), 7.09 (d, *J* = 9.1 Hz, 1H), 4.26 (q, *J* = 7.0 Hz, 2H), 1.66 (d, *J* = 14.7 Hz, 1H), 1.54-1.49 (m, 4H), 1.46 (s, 3H), 1.42 (s, 3H), 0.95 (s, 9H);

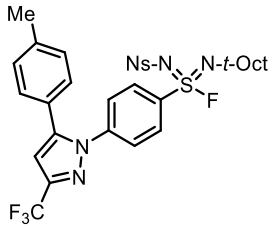
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.4, 150.0, 148.0, 133.83, 133.81, 130.2 (d, *J* = 26.9 Hz), 128.1, 124.2, 114.2, 112.7, 103.4, 66.3, 63.6 (d, *J* = 4.3 Hz), 56.3 (d, *J* = 3.1 Hz), 31.8, 31.7 (d, *J* = 2.8 Hz), 31.43, 31.37 (d, *J* = 6.2 Hz), 14.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 87.8 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1527, 1473, 1383, 1251, 1151, 1072, 955, 615;

HRMS (ESI^+) calcd. for $C_{23}H_{29}FN_4O_5S_2Na^+$ $[M+Na]^+$: 547.1456, found: 547.1456.

4-(5-(*p*-Tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (4p)



Prepared according to **General Procedure B** using sulfinamidine **3p** (661 mg, 1.00 mmol, 1.00 equiv.), THF (2.00 mL), NaH (44 mg, 60 % dispersion in mineral oil, 1.10 mmol, 1.10 equiv.) and NFSI (473 mg, 1.50 mmol, 1.50 equiv.). The crude mixture of *N*-fluorinated compound and *S*-fluorinated compound was left at room temperature for 24 h for the completion of isomerization. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:1) afforded *sulfondiimidoyl fluoride* **4p** as a colourless oil (350 mg, 0.52 mmol, 52%).

R$_f$ 0.64 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.30 (d, *J* = 8.9 Hz, 2H), 8.06 (d, *J* = 8.9 Hz, 2H), 7.98 (d, *J* = 8.9 Hz, 2H), 7.53 (d, *J* = 8.9 Hz, 2H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.14 (d, *J* = 8.0 Hz, 2H), 6.75 (s, 1H), 2.40 (s, 3H), 1.67 (d, *J* = 14.7 Hz, 1H), 1.53 (d, *J* = 14.7 Hz, 1H), 1.48 (s, 3H), 1.43 (s, 3H), 0.96 (s, 9H);

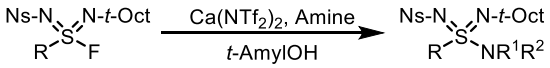
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.9, 148.1, 145.5, 144.5 (q, J = 38.8 Hz), 143.8, 140.2, 137.3 (d, J = 25.1 Hz), 130.0, 128.8, 128.6, 128.1, 125.6, 125.2, 124.2, 121.0 (q, J = 269.2 Hz), 106.9, 63.5 (d, J = 4.2 Hz), 56.3 (d, J = 2.7 Hz), 31.78 (d, J = 2.2 Hz), 31.76, 31.43, 31.35 (d, J = 5.9 Hz), 21.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = 86.7 (s), -62.5 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1530, 1348, 1237, 1161, 1135, 1107, 974, 744;

HRMS (ESI^+) calcd. for $C_{31}H_{33}F_4N_5O_4S_2Na^+$ $[M+Na]^+$: 702.1802, found: 702.1799.

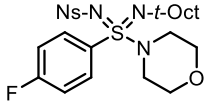
2.2.4 General Procedure C for Sulfondiimidamide Synthesis



Sulfondiimidoyl fluoride (1.00 equiv.), $Ca(NTf_2)_2$ (1.10 equiv.) and amine (2.20-6.00 equiv.) were added to an oven-dried round-bottom flask and dissolved in anhydrous *t*-AmylOH (0.5 M). The reaction was stirred at 60-80 °C until completion (judged by TLC, 10-36 h). The mixture was then diluted with CH_2Cl_2 and quenched with sat. aq. NaCl solution. The organic layer was separated and the aqueous layer was extracted with CH_2Cl_2 twice. The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by flash column chromatography to afford the desired sulfondiimidamide product.

Note: an emulsion may form during extraction in a large-scale reaction. In this case, 0.5 M aq. HCl solution is suggested to be used in aqueous workup stage instead of sat. aq. NaCl solution to facilitate easier separation.

N-((4-Fluorophenyl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ⁶-sulfaneylidene)-4-nitrobenzenesulfonamide (5a)



Sulfondiimidoyl fluoride **4a** (120 mg, 0.25 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (167 mg, 0.28 mmol, 1.10 equiv.) were added to an oven-dried 10 mL round-bottom flask and dissolved in anhydrous *t*-AmylOH (0.5 mL). Then morpholine (48 mg, 0.55 mmol, 2.20 equiv.) was added and the reaction was stirred at 60 °C for 24 h until completion (judged by TLC). The mixture was then diluted with CH_2Cl_2 (80 mL) and quenched with sat. aq. NaCl solution (120 mL). The organic layer was separated and the aqueous layer was extracted with CH_2Cl_2 (2 × 50 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) to afford *sulfondiimidamide* **5a** as a white solid (126 mg, 0.23 mmol, 93%).

Gram scale: Sulfondiimidoyl fluoride **4a** (4.40 g, 9.30 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (5.86 g, 9.77 mmol, 1.05 equiv.) were added to an oven-dried 100 mL round-bottom flask and dissolved in

anhydrous *t*-AmylOH (18.6 mL). Then morpholine (1.78 g, 20.43 mmol, 2.20 equiv.) was added and the reaction was stirred at 60 °C for 24 h until completion (judged by TLC). The mixture was then diluted with CH_2Cl_2 (250 mL) and quenched with 0.5 M aq. HCl solution (250 mL). The organic layer was separated and the aqueous layer was extracted with CH_2Cl_2 (2 × 100 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) to afford *sulfondiimidamide* **5a** as a white solid (4.51 g, 8.35 mmol, 90%). ***mp*** 55-57 °C;

R$_f$ 0.50 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.19 (d, J = 8.8 Hz, 2H), 7.84 (d, J = 8.8 Hz, 2H), 7.71-7.64 (m, 2H), 7.09-7.02 (m, 2H), 3.68 (app. t, J = 4.5 Hz, 4H), 3.11 (dt, J = 12.0, 4.5 Hz, 2H), 3.04 (dt, J = 12.0, 4.5 Hz, 2H), 1.71 (d, J = 14.5 Hz, 1H), 1.59-1.51 (m, 4H), 1.48 (s, 3H), 1.05 (s, 9H);

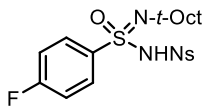
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.1 (d, J = 256.1 Hz), 149.5, 149.3, 133.5 (d, J = 3.1 Hz), 130.7 (d, J = 9.2 Hz), 127.5, 123.8, 116.1 (d, J = 22.7 Hz), 66.6, 60.3, 57.6, 47.0, 32.1, 31.92, 31.87, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.1 (tt, J = 7.9, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1350, 1298, 1154, 1088, 1050, 921;

HRMS (ESI^+) calcd. for $C_{24}H_{33}FN_4O_5S_2Na^+$ $[M+Na]^+$: 563.1769, found: 563.1766.

N-(4-Fluoro-*N*-(2,4,4-trimethylpentan-2-yl)phenylsulfonimidoyl)-4-nitrobenzenesulfonamide (5a')



R$_f$ 0.60 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.28 (d, J = 8.8 Hz, 2H), 8.09 (d, J = 8.8 Hz, 2H), 7.96-7.90 (m, 2H), 7.19-7.11 (m, 2H), 6.15 (s, 1H), 1.60 (d, J = 14.9 Hz, 1H), 1.49 (d, J = 14.9 Hz, 1H), 1.32 (s, 3H), 1.16 (s, 3H), 0.95 (s, 9H);

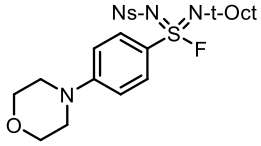
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.6 (d, *J* = 257.2 Hz), 149.8, 148.9, 137.4 (d, *J* = 3.2 Hz), 130.6 (d, *J* = 9.6 Hz), 128.2, 124.0, 116.5 (d, *J* = 22.9 Hz), 61.9, 56.1, 31.6, 31.5, 30.1, 28.2 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -103.1 (tt, *J* = 8.5, 4.8 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1590, 1530, 1493, 1384, 1351, 1302, 1261, 1154, 1091, 1039, 1027;

HRMS (ESI^+) calcd. for $C_{20}H_{27}FN_3O_5S_2^+$ $[M+H]^+$: 472.1371, found: 472.1371.

4-Morpholino-*N*-((4-nitrophenyl)sulfonyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzenesulfondiimidoyl fluoride (5a'')



R$_f$ 0.62 (petrol/ethyl acetate, 1:1);

^{1}H NMR (400 MHz, CD_3CN): δ (ppm) = 8.19 (d, *J* = 8.8 Hz, 2H), 7.87 (d, *J* = 8.8 Hz, 2H), 7.58 (d, *J* = 9.3 Hz, 2H), 6.80 (d, *J* = 9.3 Hz, 2H), 3.77-3.69 (m, 4H), 3.29-3.21 (m, 4H), 1.69 (d, *J* = 14.6 Hz, 1H), 1.55 (d, *J* = 14.6 Hz, 1H), 1.51 (s, 3H), 1.47 (s, 3H), 0.98 (s, 9H);

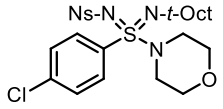
^{13}C NMR (101 MHz, CD_3CN): δ (ppm) = 155.7, 150.8, 149.0, 130.4, 128.9, 125.1, 124.2 (d, *J* = 24.3 Hz), 113.7, 66.9, 63.3 (d, *J* = 4.4 Hz), 57.0 (d, *J* = 3.2 Hz), 47.5, 32.3, 32.2 (d, *J* = 2.5 Hz), 31.83, 31.77 (d, *J* = 6.4 Hz) (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, CD_3CN): δ (ppm) = 84.9 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1590, 1530, 1349, 1332, 1304, 1247, 1161, 1089, 1053, 928;

HRMS (ESI^+) calcd. for $C_{24}H_{33}FN_4O_5S_2Na^+$ $[M+ Na]^+$: 563.1769, found: 563.1771.

***N*-((4-Chlorophenyl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5b)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4b** (88 mg, 0.18 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (119 mg, 0.20 mmol, 1.10 equiv.), morpholine (35 mg, 0.40 mmol, 2.20 equiv.) and *t*-AmylOH (0.36 mL). The reaction was stirred at 60 °C for 24 h. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:2) afforded *sulfondiimidamide* **5b** as a white solid (95 mg, 0.17 mmol, 94%).

mp 128-130 °C;

R$_f$ 0.61 (petrol/ethyl acetate, 2:1);

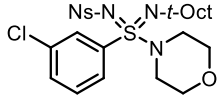
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.19 (d, *J* = 8.9 Hz, 2H), 7.84 (d, *J* = 8.9 Hz, 2H), 7.59 (d, *J* = 8.8 Hz, 2H), 7.34 (d, *J* = 8.8 Hz, 2H), 3.70-3.65 (m, 4H), 3.11 (dt, *J* = 12.0, 4.5 Hz, 2H), 3.04 (dt, *J* = 12.0, 4.5 Hz, 2H), 1.71 (d, *J* = 14.5 Hz, 1H), 1.55 (s, 3H), 1.55 (d, *J* = 14.5 Hz, 1H), 1.48 (s, 3H), 1.05 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.4, 149.3, 139.4, 136.1, 129.4, 129.2, 127.5, 123.8, 66.6, 60.3, 57.5, 47.0, 32.1, 31.92, 31.86, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1299, 1257, 1153, 1087, 1062, 1009, 919, 746;

HRMS (ESI$^+$) calcd. for $C_{24}H_{33}ClN_4O_5S_2Na^+$ $[M+Na]^+$: 579.1473, found: 579.1475.

***N*-((3-Chlorophenyl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5c)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4c** (160 mg, 0.33 mmol,

1.00 equiv.), $Ca(NTf_2)_2$ (216 mg, 0.36 mmol, 1.10 equiv.), morpholine (63 mg, 0.72 mmol, 2.20 equiv.) and *t*-AmylOH (0.65 mL). The reaction was stirred at 60 °C for 24 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfondiimidamide* **5c** as a white solid (162 mg, 0.29 mmol, 89%).

mp 112-114 °C;

R_f 0.73 (petrol/ethyl acetate, 1:1);

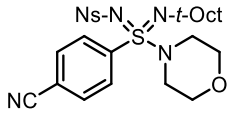
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.16 (d, *J* = 8.8 Hz, 2H), 7.78 (d, *J* = 8.8 Hz, 2H), 7.54 (ddd, *J* = 8.0, 2.0, 1.0 Hz, 1H), 7.43 (ddd, *J* = 8.0, 2.0, 1.0 Hz, 1H), 7.39 (t, *J* = 2.0 Hz, 1H), 7.31 (t, *J* = 8.0 Hz, 1H), 3.69-3.64 (m, 4H), 3.10 (dt, *J* = 12.0, 4.2 Hz, 2H), 3.03 (dt, *J* = 12.0, 4.2 Hz, 2H), 1.75 (d, *J* = 14.5 Hz, 1H), 1.61 (s, 3H), 1.57 (d, *J* = 14.5 Hz, 1H), 1.50 (s, 3H), 1.06 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.3, 149.1, 139.0, 135.0, 132.6, 130.2, 127.6, 127.4, 126.3, 123.8, 66.5, 60.5, 57.4, 46.9, 32.0, 31.9, 31.8, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1296, 1255, 1153, 1112, 1088, 1049, 917, 733, 677;

HRMS (ESI^+) calcd. for $C_{24}H_{33}ClN_4O_5S_2Na^+$ $[M+Na]^+$: 579.1473, found: 579.1469.

N-((4-Cyanophenyl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5d)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4d** (200 mg, 0.42 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (275 mg, 0.46 mmol, 1.10 equiv.), morpholine (80 mg, 0.92 mmol, 2.20 equiv.) and *t*-AmylOH (0.83 mL). The reaction was stirred at 60 °C for 12 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfondiimidamide* **5d** as a white solid (213 mg, 0.39 mmol, 93%).

mp 154-156 °C;

R$_f$ 0.54 (petrol/ethyl acetate, 1:1);

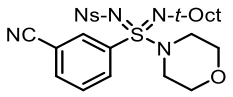
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.21 (d, *J* = 8.9 Hz, 2H), 7.87 (d, *J* = 8.9 Hz, 2H), 7.81 (d, *J* = 8.8 Hz, 2H), 7.71 (d, *J* = 8.8 Hz, 2H), 3.66 (app. t, *J* = 4.8 Hz, 4H), 3.09 (dt, *J* = 12.0, 4.6 Hz, 2H), 3.01 (dt, *J* = 12.0, 4.6 Hz, 2H), 1.69 (d, *J* = 14.5 Hz, 1H), 1.54 (d, *J* = 14.5 Hz, 1H), 1.52 (s, 3H), 1.46 (s, 3H), 1.02 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.4, 149.1, 142.2, 132.7, 128.5, 127.4, 123.9, 117.1, 116.2, 66.4, 60.5, 57.3, 46.9, 31.9, 31.79, 31.75, 31.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1299, 1257, 1154, 1086, 1045, 917, 733;

HRMS (ESI^+) calcd. for $C_{25}H_{33}N_5O_5S_2Na^+$ $[M+Na]^+$: 570.1815, found: 570.1812.

_N_-((3-Cyanophenyl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5e)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4e** (285 mg, 0.59 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (392 mg, 0.46 mmol, 1.10 equiv.), morpholine (114 mg, 1.31 mmol, 2.20 equiv.) and *t*-AmylOH (1.19 mL). The reaction was stirred at 60 °C for 12 h. Purification by flash column chromatography (petrol/ethyl acetate, 2:1 to 1:1) afforded *sulfondiimidamide* **5e** as a white solid (300 mg, 0.55 mmol, 92%).

mp 160-162 °C;

R$_f$ 0.60 (petrol/ethyl acetate, 1:1);

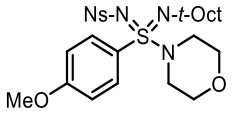
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.24 (d, *J* = 8.8 Hz, 2H), 7.93-7.85 (m, 2H), 7.87 (d, *J* = 8.8 Hz, 2H), 7.80 (dt, *J* = 7.8, 1.3 Hz, 1H), 7.56 (t, *J* = 7.8 Hz, 1H), 3.73-3.68 (m, 4H), 3.12 (dt, *J* = 12.0, 4.6 Hz, 2H), 3.04 (dt, *J* = 12.0, 4.6 Hz, 2H), 1.74 (d, *J* = 14.7 Hz, 1H), 1.59 (d, *J* = 14.7 Hz, 1H), 1.58 (s, 3H), 1.50 (s, 3H), 1.06 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.6, 149.1, 139.4, 135.7, 131.73, 131.65, 130.1, 127.5, 124.1, 117.1, 113.7, 66.5, 60.8, 57.5, 47.1, 32.1, 31.91, 31.90, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1385, 1350, 1298, 1257, 1154, 1088, 1064, 922;

HRMS (ESI^+) calcd. for $C_{25}H_{33}N_5O_5S_2Na^+$ $[M+Na]^+$: 570.1815, found: 570.1811.

N-((4-Methoxyphenyl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5f)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4f** (110 mg, 0.23 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (150 mg, 0.25 mmol, 1.10 equiv.), morpholine (44 mg, 0.51 mmol, 2.20 equiv.) and *t*-AmylOH (0.45 mL). The reaction was stirred at 60 °C for 24 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfondiimidamide* **5f** as a white solid (115 mg, 0.21 mmol, 92%).

mp 132-134 °C;

R$_f$ 0.59 (petrol/ethyl acetate, 1:1);

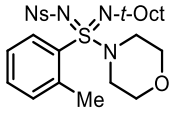
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.10 (d, J = 8.9 Hz, 2H), 7.77 (d, J = 8.9 Hz, 2H), 7.50 (d, J = 9.0 Hz, 2H), 6.75 (d, J = 9.0 Hz, 2H), 3.77 (s, 3H), 3.68-3.63 (m, 4H), 3.10 (dt, J = 12.0, 4.1 Hz, 2H), 3.03 (dt, J = 12.0, 4.1 Hz, 2H), 1.70 (d, J = 14.5 Hz, 1H), 1.56 (s, 3H), 1.53 (d, J = 14.5 Hz, 1H), 1.47 (s, 3H), 1.04 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 162.9, 149.6, 149.1, 130.0, 128.5, 127.6, 123.6, 113.9, 66.6, 59.9, 57.6, 55.7, 46.8, 32.1, 31.9, 31.8, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1530, 1383, 1348, 1296, 1254, 1151, 1087, 1063, 914, 733;

HRMS (ESI$^+$) calcd. for $C_{25}H_{37}N_4O_6S_2^+$ [M+H]$^+$: 553.2149, found: 553.2144.

***N*-(Morpholino(o-tolyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5g)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4g** (175 mg, 0.37 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (244 mg, 0.41 mmol, 1.10 equiv.), morpholine (129 mg, 1.48 mmol, 4.00 equiv.) and *t*-AmylOH (0.75 mL). The reaction was stirred at 75 °C for 18 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 2:1) afforded *sulfondiimidamide* **5g** as a white solid (149 mg, 0.28 mmol, 75%).

mp 114-116 °C;

R$_f$ 0.46 (petrol/ethyl acetate, 2:1);

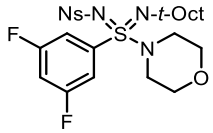
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.09 (d, *J* = 8.9 Hz, 2H), 8.08-8.05 (m, 1H), 7.71 (d, *J* = 8.9 Hz, 2H), 7.36 (td, *J* = 7.5, 1.4 Hz, 1H), 7.26-7.21 (m, 1H), 7.06 (dt, *J* = 7.5, 1.4 Hz, 1H), 3.69-3.61 (m, 4H), 3.29 (ddd, *J* = 12.3, 6.0, 4.0 Hz, 2H), 3.16 (ddd, *J* = 12.3, 6.0, 4.0 Hz, 2H), 2.30 (s, 3H), 1.72 (d, *J* = 14.5 Hz, 1H), 1.66 (d, *J* = 14.5 Hz, 1H), 1.51 (s, 3H), 1.49 (s, 3H), 1.04 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.12, 149.10, 138.0, 137.0, 133.6, 132.6, 131.8, 127.5, 126.4, 123.6, 66.4, 60.4, 57.7, 45.3, 32.1, 31.9, 31.8, 31.5, 21.2 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) =1527, 1349, 1296, 1257, 1151, 1061, 1034, 919, 734;

HRMS (ESI$^+$) calcd. for $C_{25}H_{36}N_4O_5S_2Na^+$ [M+Na]$^+$: 559.2019, found: 559.2010.

***N*-((3,5-Difluorophenyl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)- λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5h)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4h** (310 mg, 0.63 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (417 mg, 0.70 mmol, 1.10 equiv.), morpholine (121 mg, 1.39 mmol, 2.20 equiv.) and *t*-AmylOH (1.26 mL). The reaction was stirred at 60 °C for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 2:1) afforded *sulfondiimidamide* **5h** as a white solid (328 mg, 0.59 mmol, 93%).

mp 152-154 °C;

R$_f$ 0.37 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.23 (d, *J* = 8.8 Hz, 2H), 7.88 (d, *J* = 8.8 Hz, 2H), 7.16-7.13 (m, 2H), 6.96 (tt, *J* = 8.2, 2.3 Hz, 1H), 3.69 (app. t, *J* = 4.7 Hz, 4H), 3.11 (dt, *J* = 12.0, 4.6 Hz, 2H), 3.04 (dt, *J* = 12.0, 4.6 Hz, 2H), 1.75 (d, *J* = 14.5 Hz, 1H), 1.58 (d, *J* = 14.5 Hz, 1H), 1.58 (s, 3H), 1.49 (s, 3H), 1.06 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 162.6 (dd, *J* = 254.9, 11.7 Hz), 149.5, 149.1, 141.2 (t, *J* = 8.2 Hz), 127.5, 124.0, 111.6-111.3 (second-order multiplet), 108.3 (t, *J* = 25.1 Hz), 66.5, 60.8, 57.5, 47.0, 32.0, 31.90, 31.86, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

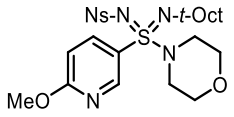
^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.22- -105.24 (second-order multiplet);

Note: The second-order multiplet in the ^{13}C and ^{19}F NMR spectra arise due to virtual coupling;

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1601, 1529, 1350, 1293, 1257, 1157, 1090, 1066, 920;

HRMS (ESI^+) calcd. for $C_{24}H_{32}F_2N_4O_5S_2Na^+$ $[M+Na]^+$: 581.1674, found: 581.1664.

***N*-((6-Methoxypyridin-3-yl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5i)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4i** (290 mg, 0.60 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (394 mg, 0.66 mmol, 1.10 equiv.), morpholine (115 mg, 1.32 mmol, 2.20 equiv.) and *t*-AmylOH (1.20 mL). The reaction was stirred at 60 °C for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfondiimidamide* **5i** as a white solid (307 mg, 0.56 mmol, 93%).

mp 140-142 °C;

R$_f$ 0.44 (petrol/ethyl acetate, 2:1);

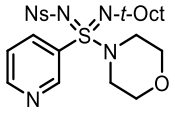
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.29 (d, *J* = 2.6 Hz, 1H), 8.14 (d, *J* = 8.8 Hz, 2H), 7.80 (d, *J* = 8.8 Hz, 2H), 7.77 (dd, *J* = 8.9, 2.6 Hz, 1H), 6.65 (d, *J* = 8.9 Hz, 1H), 3.88 (s, 3H), 3.66 (app. t, *J* = 4.7 Hz, 4H), 3.12 (dt, *J* = 12.0, 4.5 Hz, 2H), 3.04 (dt, *J* = 12.0, 4.5 Hz, 2H), 1.69 (d, *J* = 14.5 Hz, 1H), 1.54 (s, 3H), 1.52 (d, *J* = 14.5 Hz, 1H), 1.45 (s, 3H), 1.02 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.2, 149.4, 149.3, 148.0, 138.4, 127.5, 126.6, 123.8, 111.0, 66.5, 60.2, 57.5, 54.4, 46.8, 32.1, 31.84, 31.80, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1586, 1528, 1479, 1349, 1298, 1256, 1154, 1089, 1050, 1012, 919, 736;

HRMS (ESI$^+$) calcd. for $C_{24}H_{35}N_5O_6S_2Na^+$ $[M+Na]^+$: 576.1921, found: 576.1915.

***N*-(Morpholino(pyridin-3-yl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5j)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4j** (230 mg, 0.50 mmol,

1.00 equiv.), $Ca(NTf_2)_2$ (330 mg, 0.55 mmol, 1.10 equiv.), morpholine (96 mg, 1.10 mmol, 2.20 equiv.) and *t*-AmylOH (1.00 mL). The reaction was stirred at 60 °C for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 2:1 to 1:2) afforded *sulfondiimidamide* **5j** as a white solid (240 mg, 0.46 mmol, 92%).

mp 126-128 °C;

R_f 0.33 (petrol/ethyl acetate, 1:2);

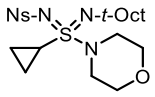
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.74 (dd, *J* = 2.5, 0.8 Hz, 1H), 8.65 (dd, *J* = 4.8, 1.5 Hz, 1H), 8.14 (d, *J* = 8.9 Hz, 2H), 7.95 (ddd, *J* = 8.2, 2.5, 1.5 Hz, 1H), 7.78 (d, *J* = 8.9 Hz, 2H), 7.32 (ddd, *J* = 8.2, 4.8, 0.8 Hz, 1H), 3.67-3.61 (m, 4H), 3.11 (dt, *J* = 12.5, 4.7 Hz, 2H), 3.02 (dt, *J* = 12.5, 4.7 Hz, 2H), 1.70 (d, *J* = 14.5 Hz, 1H), 1.54 (s, 3H), 1.53 (d, *J* = 14.5 Hz, 1H), 1.46 (s, 3H), 1.01 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 152.8, 149.3, 149.0, 148.5, 135.8, 134.3, 127.3, 123.9, 123.4, 66.4, 60.4, 57.3, 46.8, 32.0, 31.8, 31.7, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1350, 1297, 1257, 1154, 1110, 1089, 1062, 1011, 921, 742;

HRMS (ESI^+) calcd. for $C_{23}H_{33}N_5O_5S_2Na^+$ $[M+Na]^+$: 546.1815, found: 546.1808.

N-(Cyclopropyl(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5k)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4k** (390 mg, 0.93 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (614 mg, 1.02 mmol, 1.10 equiv.), morpholine (178 mg, 2.04 mmol, 2.20 equiv.) and *t*-AmylOH (1.86 mL). The reaction was stirred at 60 °C for 24 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfondiimidamide* **5k** as a white solid (413 mg, 0.85 mmol, 91%).

mp 125-127 °C;

R_f 0.23 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.25 (d, *J* = 8.9 Hz, 2H), 8.06 (d, *J* = 8.9 Hz, 2H), 3.71-3.62 (m, 4H), 3.28 (ddd, *J* = 12.0, 6.0, 3.2 Hz, 2H), 3.19 (ddd, *J* = 12.0, 6.0, 3.2 Hz, 2H), 2.26 (tt, *J* = 7.6, 4.5 Hz, 1H), 1.44 (d, *J* = 14.5 Hz, 1H), 1.36 (s, 3H), 1.36 (d, *J* = 14.5 Hz, 1H), 1.29 (s, 3H), 1.26 (dt, *J* = 5.3, 2.7 Hz, 2H), 1.01-0.95 (m, 1H), 0.93-0.83 (m, 10H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.5, 149.2, 127.4, 123.9, 66.6, 59.5, 57.8, 47.2, 32.0, 31.7, 31.6, 31.3, 29.2, 7.6, 5.6;

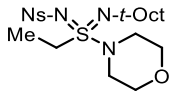
Notes:

1. For *gem*-dimethyl carbons in *tert*-octyl group, $NC\boldsymbol{(CH_3)_2}CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom;
2. For 2 secondary carbons in cyclopropane ring, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom;

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1527, 1349, 1293, 1256, 1149, 1091, 1057, 918, 733;

HRMS (ESI^+) calcd. for $C_{21}H_{35}N_4O_5S_2^+$ $[M+H]^+$: 487.2043, found: 487.2045.

_N_-(Ethyl(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5l)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4l** (160 mg, 0.39 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (259 mg, 0.43 mmol, 1.10 equiv.), *t*-AmylOH (0.79 mL) and morpholine (75 mg, 0.86 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 10 h. Ethyl acetate was used for extraction instead of CH_2Cl_2 because of the better aqueous solubility of this substrate. Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 20:1) afforded *sulfondiimidamide* **5l** as a colourless oil (96 mg, 0.20 mmol, 52%).

R_f 0.38 (petrol/ethyl acetate, 1:1);

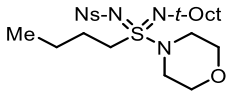
^{1}H NMR (400 MHz, CD_3CN): δ (ppm) = 8.30 (d, J = 9.0 Hz, 2H), 8.07 (d, J = 9.0 Hz, 2H), 3.69-3.60 (m, 4H), 3.60-3.47 (m, 2H), 3.27 (t, J = 4.6 Hz, 4H), 1.56 (d, J = 14.4 Hz, 1H), 1.45 (d, J = 14.4 Hz, 1H), 1.41 (s, 3H), 1.36 (s, 3H), 1.20 (t, J = 7.4 Hz, 3H), 1.01 (s, 9H);

^{13}C NMR (101 MHz, CD_3CN): δ (ppm) = 151.3, 150.5, 128.1, 125.2, 67.5, 59.8, 58.0, 50.7, 47.8, 32.5, 32.3, 32.1, 31.8, 9.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 1528, 1350, 1256, 1148, 1091, 1066, 924, 739;

HRMS (ESI^+) calcd. for $C_{20}H_{34}N_4O_5S_2Na^+$ $[M+Na]^+$: 497.1863, found: 497.1856.

***N*-(Butyl(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5m)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4m** (216 mg, 0.50 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (328 mg, 0.55 mmol, 1.10 equiv.), *t*-AmylOH (1.0 mL) and morpholine (96 mg, 1.10 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 22 h. Ethyl acetate was used for extraction instead of CH_2Cl_2 because of the better aqueous solubility of this substrate. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 2:1) afforded *sulfondiimidamide* **5m** as a pale-yellow oil (110 mg, 0.22 mmol, 44%).

R$_f$ 0.23 (CH_2Cl_2);

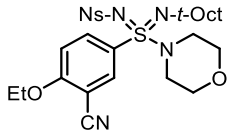
^{1}H NMR (400 MHz, CD_3CN): δ (ppm) = 8.30 (d, J = 8.9 Hz, 2H), 8.07 (d, J = 8.9 Hz, 2H), 3.69-3.59 (m, 4H), 3.57-3.38 (m, 2H), 3.29-3.23 (m, 4H), 1.72-1.60 (m, 1H), 1.59-1.50 (m, 2H), 1.45 (d, J = 14.4 Hz, 1H), 1.42 (s, 3H), 1.36 (s, 3H), 1.34-1.25 (m, 2H), 1.01 (s, 9H), 0.83 (t, J = 7.4 Hz, 3H);

^{13}C NMR (101 MHz, CD_3CN): δ (ppm) = 151.4, 150.5, 128.1, 125.2, 67.5, 59.9, 58.0, 55.5, 47.8, 32.5, 32.3, 32.1, 31.9, 26.5, 22.0, 13.9 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1292, 1256, 1148, 1089, 1061, 923, 743, 633;

HRMS (ESI^+) calcd. for $C_{22}H_{38}N_4O_5S_2Na^+$ $[M+Na]^+$: 525.2176, found: 525.2175.

***N*-((3-Cyano-4-ethoxyphenyl)(morpholino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5o)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4o** (510 mg, 0.97 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (642 mg, 1.07 mmol, 1.10 equiv.), morpholine (186 mg, 2.13 mmol, 2.20 equiv.) and *t*-AmylOH (1.94 mL). The reaction was stirred at 60 °C for 24 h. 0.5 M aq. HCl solution was used to quench the reaction (instead of sat. aq. NaCl solution) and the aqueous layers was extracted with ethyl acetate (instead of CH_2Cl_2). Purification by flash column chromatography (petrol/ethyl acetate, 1:1 to 1:2) afforded *sulfondiimidamide* **5o** as a white solid (546 mg, 0.92 mmol, 95%).

mp 183-185 °C;

R_f 0.58 (petrol/ethyl acetate, 2:3);

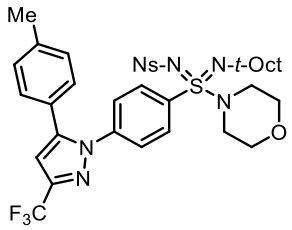
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.23 (d, *J* = 8.8 Hz, 2H), 7.88 (d, *J* = 8.8 Hz, 2H), 7.84-7.78 (m, 2H), 6.92 (d, *J* = 8.9 Hz, 1H), 4.19 (q, *J* = 7.0 Hz, 2H), 3.72-3.67 (m, 4H), 3.10 (dt, *J* = 12.0, 4.6 Hz, 2H), 3.03 (dt, *J* = 12.0, 4.6 Hz, 2H), 1.71 (d, *J* = 14.5 Hz, 1H), 1.56 (d, *J* = 14.5 Hz, 1H), 1.55 (s, 3H), 1.51 (t, *J* = 7.0 Hz, 3H), 1.48 (s, 3H), 1.05 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 163.3, 149.5, 149.3, 134.2, 134.1, 129.6, 127.5, 124.0, 114.7, 112.1, 102.8, 66.6, 66.0, 60.6, 57.6, 47.0, 32.1, 31.92, 31.89, 31.5, 14.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, $NC(\boldsymbol{CH_3})_2CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 1529, 1349, 1294, 1256, 1152, 1063, 920, 735;

HRMS (ESI^+) calcd. for $C_{27}H_{38}N_5O_6S_2^+$ $[M+H]^+$: 592.2258, found: 592.2261.

***N*-(Morpholino(4-(5-(*p*-tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)phenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5p)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4p** (401 mg, 0.59 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (390 mg, 0.65 mmol, 1.10 equiv.), morpholine (112 mg, 1.29 mmol, 2.20 equiv.) and *t*-AmylOH (1.18 mL). The reaction was stirred at 60 °C for 24 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfondiimidamide* **5p** as a white solid (386 mg, 0.52 mmol, 88%).

mp 165-167 °C;

R$_f$ 0.48 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.11 (d, *J* = 8.9 Hz, 2H), 7.82 (d, *J* = 8.9 Hz, 2H), 7.63 (d, *J* = 8.8 Hz, 2H), 7.37 (d, *J* = 8.8 Hz, 2H), 7.20 (d, *J* = 8.0 Hz, 2H), 7.12 (d, *J* = 8.0 Hz, 2H), 6.72 (s, 1H), 3.65 (app. t, *J* = 4.5 Hz, 4H), 3.06 (dt, *J* = 11.8, 4.5 Hz, 2H), 2.99 (dt, *J* = 11.8, 4.5 Hz, 2H), 2.38 (s, 3H), 1.72 (d, *J* = 14.5 Hz, 1H), 1.58 (d, *J* = 14.5 Hz, 1H), 1.57 (s, 3H), 1.49 (s, 3H), 1.04 (s, 9H);

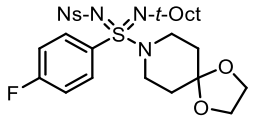
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.4, 149.3, 145.2, 144.1 (q, *J* = 38.5 Hz), 142.5, 139.9, 137.2, 129.8, 128.8, 128.7, 127.4, 125.8, 125.2, 123.8, 121.1 (q, *J* = 269.3 Hz), 106.5, 66.4, 60.4, 57.5, 46.9, 32.0, 31.81, 31.78, 31.5, 21.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -62.4 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1349, 1299, 1236, 1156, 1089, 1062, 918, 733;

HRMS (ESI^+) calcd. for $C_{35}H_{42}F_3N_6O_5S_2^+$ $[M+H]^+$: 747.2605, found: 747.2604.

***N*-((4-Fluorophenyl)(1,4-dioxa-8-azaspiro[4.5]decan-8-yl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5q)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (220 mg, 0.47 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (307 mg, 0.51 mmol, 1.10 equiv.), *t*-AmylOH (0.94 mL) and 1,4-dioxa-8-azaspiro[4.5]decane (148 mg, 1.03 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfondiimidamide* **5q** as a white solid (254 mg, 0.43 mmol, 92%).

mp 86-88 °C;

R$_f$ 0.45 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.15 (d, *J* = 8.9 Hz, 2H), 7.78 (d, *J* = 8.9 Hz, 2H), 7.65-7.60 (m, 2H), 7.03-6.97 (m, 2H), 3.89 (s, 4H), 3.26 (ddd, *J* = 11.9, 6.5, 4.5 Hz, 2H), 3.19 (ddd, *J* = 11.9, 6.5, 4.5 Hz, 2H), 1.76-1.66 (m, 5H), 1.58-1.52 (m, 4H), 1.48 (s, 3H), 1.04 (s, 9H);

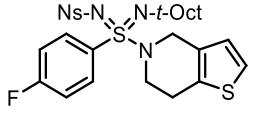
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.9 (d, *J* = 255.6 Hz), 149.6, 149.2, 134.3 (d, *J* = 3.1 Hz), 130.4 (d, *J* = 9.2 Hz), 127.5, 123.7, 116.0 (d, *J* = 22.6 Hz), 106.1, 64.6, 60.1, 57.6, 44.9, 34.9, 31.93, 31.85, 31.8, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, $NC\boldsymbol{(CH_3)_2}CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.6 (tt, *J* = 8.0, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1349, 1300, 1226, 1153, 1088, 1040;

HRMS (ESI^+) calcd. for $C_{27}H_{37}FN_4O_6S_2Na^+$ $[M+Na]^+$: 619.2031, found: 619.2027.

***N*-((6,7-Dihydrothieno[3,2-c]pyridin-5(4*H*)-yl)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5r)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (115 mg, 0.24 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (160 mg, 0.27 mmol, 1.10 equiv.), *t*-AmylOH (0.48 mL) and 4,5,6,7-tetrahydrothieno[3,2-*c*]pyridine (74 mg, 0.53 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 3:1) afforded *sulfondiimidamide* **5r** as a pale-yellow oil (117 mg, 0.20 mmol, 81%).

R$_f$ 0.45 (petrol/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.13 (d, *J* = 8.8 Hz, 2H), 7.78 (d, *J* = 8.8 Hz, 2H), 7.74-7.68 (m, 2H), 7.12 (d, *J* = 5.2 Hz, 1H), 7.04-6.97 (m, 2H), 6.68 (d, *J* = 5.2 Hz, 1H), 4.35 (d, *J* = 15.1 Hz, 1H), 4.20 (d, *J* = 15.1 Hz, 1H), 3.59 (ddd, *J* = 12.0, 6.8, 4.9 Hz, 1H), 3.50 (dt, *J* = 12.0, 5.5 Hz, 1H), 2.94-2.73 (m, 2H), 1.68 (d, *J* = 14.5 Hz, 1H), 1.57 (d, *J* = 14.5 Hz, 1H), 1.54 (s, 3H), 1.46 (s, 3H), 1.06 (s, 9H);

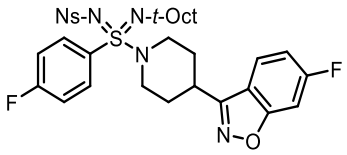
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.0 (d, *J* = 256.2 Hz), 149.5, 149.2, 135.0 (d, *J* = 3.1 Hz), 132.8, 131.1, 130.7 (d, *J* = 9.2 Hz), 127.5, 124.8, 124.2, 123.7, 116.0 (d, *J* = 22.6 Hz), 60.2, 57.6, 46.5, 44.1, 31.94, 31.90, 31.8, 31.6, 25.6 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.2 (tt, *J* = 8.0, 5.0 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 2889, 1383, 1252, 1153, 1088, 955;

HRMS (ESI^+) calcd. for $C_{27}H_{33}FN_4O_4S_3Na^+$ $[M+Na]^+$: 615.1540, found: 615.1536.

***N*-((4-(6-Fluorobenzo[*d*]isoxazol-3-yl)piperidin-1-yl)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)- λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5s)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (180 mg, 0.38 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (251 mg, 0.42 mmol, 1.10 equiv.), *t*-AmylOH (0.76 mL) and 6-fluoro-3-(4-piperidinyl)-1,2-benzisoxazole (184 mg, 0.84 mmol, 2.20 equiv.). The reaction was stirred at 60 °C

for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 2:1) afforded *sulfondiimidamide* **5s** as a white solid (220 mg, 0.33 mmol, 86%).

mp 78-80 °C;

R_f 0.77 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.16 (d, *J* = 8.8 Hz, 2H), 7.82 (d, *J* = 8.8 Hz, 2H), 7.73-7.68 (m, 2H), 7.54 (dd, *J* = 8.7, 5.0 Hz, 1H), 7.21 (dd, *J* = 8.4, 2.1 Hz, 1H), 7.07-7.01 (m, 3H), 4.09-4.02 (m, 1H), 3.89-3.83 (m, 1H), 3.10 (tt, *J* = 11.0, 3.9 Hz, 1H), 2.83 (td, *J* = 11.5, 2.5 Hz, 1H), 2.53 (td, *J* = 11.5, 2.5 Hz, 1H), 2.21-2.11 (m, 2H), 2.09-1.92 (m, 2H), 1.70 (d, *J* = 14.5 Hz, 1H), 1.56 (d, *J* = 14.5 Hz, 1H), 1.56 (s, 3H), 1.50 (s, 3H), 1.05 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.9 (d, *J* = 255.9 Hz), 164.3 (d, *J* = 251.5 Hz), 163.9 (d, *J* = 13.5 Hz), 159.9, 149.6, 149.2, 134.2 (d, *J* = 2.3 Hz), 130.5 (d, *J* = 9.1 Hz), 127.5, 123.8, 122.0 (d, *J* = 11.2 Hz), 117.1, 116.1 (d, *J* = 22.5 Hz), 112.8 (d, *J* = 25.5 Hz), 97.6 (d, *J* = 26.9 Hz), 60.1, 57.6, 47.8, 44.9, 33.5, 31.90, 31.86, 31.8, 31.5, 30.5, 29.8;

Notes:

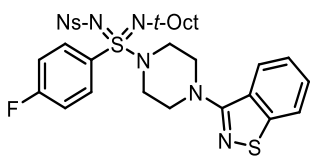
1. For *gem*-dimethyl carbons in *tert*-octyl group, $NC(\boldsymbol{CH_3})_2CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom;
2. For 4 secondary carbons in piperidine ring, 4 peaks were found instead of 2 due to the loss of symmetry caused by chiral sulfur atom**;**

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.3 (tt, *J* = 8.0, 4.9 Hz), -108.8 (td, *J* = 8.6, 5.1 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1298, 1269, 1229, 1153, 1087, 1050, 913, 839, 736;

HRMS (ESI^+) calcd. for $C_{32}H_{38}F_2N_5O_5S_2^+$ $[M+H]^+$: 674.2277, found: 674.2272.

***N*-((4-(Benzo[*d*]isothiazol-3-yl)piperazin-1-yl)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)- λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5t)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (180 mg, 0.38 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (251 mg, 0.42 mmol, 1.10 equiv.), *t*-AmylOH (0.76 mL) and 3-(piperazin-1-yl)benzo[*d*]isothiazole (184 mg, 0.84 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 4:1 to 2:1) afforded *sulfondiimidamide* **5t** as a pale-yellow solid (238 mg, 0.35 mmol, 93%).

mp 66-68 °C;

R_f 0.54 (petrol/ethyl acetate, 2:1);

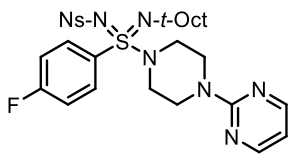
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.20 (d, *J* = 8.8 Hz, 2H), 7.86 (d, *J* = 8.8 Hz, 2H), 7.81 (dt, *J* = 8.1, 1.0 Hz, 1H), 7.79 (dt, *J* = 8.1, 1.0 Hz, 1H), 7.75-7.70 (m, 2H), 7.47 (ddd, *J* = 8.1, 7.0, 1.1 Hz, 1H), 7.34 (ddd, *J* = 8.1, 7.0, 1.1 Hz, 1H), 7.10-7.05 (m, 2H), 3.60 (ddd, *J* = 12.7, 6.5, 3.3 Hz, 2H), 3.54 (ddd, *J* = 12.7, 6.5, 3.3 Hz, 2H), 3.39 (ddd, *J* = 10.0, 6.4, 3.3 Hz, 2H), 3.33 (ddd, *J* = 10.0, 6.4, 3.3 Hz, 2H), 1.75 (d, *J* = 14.5 Hz, 1H), 1.60 (s, 3H), 1.60 (d, *J* = 14.5 Hz, 1H), 1.54 (s, 3H), 1.08 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.0 (d, *J* = 256.0 Hz), 163.0, 152.9, 149.5, 149.3, 133.8 (d, *J* = 3.1 Hz), 130.6 (d, *J* = 9.2 Hz), 127.9, 127.6, 127.5, 124.3, 123.8, 123.5, 120.8, 116.1 (d, *J* = 22.6 Hz), 60.3, 57.6, 49.9, 46.5, 32.0, 31.94, 31.87, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.1 (tt, *J* = 8.0, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1489, 1383, 1349, 1302, 1261, 1230, 1153, 1087, 1052, 925, 737; **HRMS** (ESI^+) calcd. for $C_{31}H_{38}FN_6O_4S_3^+$ $[M+H]^+$: 673.2095, found: 673.2093.

_N_-((4-Fluorophenyl)(4-(pyrimidin-2-yl)piperazin-1-yl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5u)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (86 mg, 0.18 mmol,

1.00 equiv.), $Ca(NTf_2)_2$ (120 mg, 0.20 mmol, 1.10 equiv.), *t*-AmylOH (0.36 mL) and 2-(piperazin-1-yl)pyrimidine (66 mg, 0.40 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 2:1 to 1:1) afforded *sulfondiimidamide* **5u** as a white solid (99 mg, 0.16 mmol, 88%).

mp 176-178 °C;

R_f 0.31 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.25 (d, J = 4.8 Hz, 2H), 8.17 (d, J = 8.8 Hz, 2H), 7.84 (d, J = 8.8 Hz, 2H), 7.69-7.63 (m, 2H), 7.05-6.98 (m, 2H), 6.50 (t, J = 4.8 Hz, 1H), 3.90-3.82 (m, 4H), 3.22-3.08 (m, 4H), 1.72 (d, J = 14.5 Hz, 1H), 1.58 (s, 3H), 1.57 (d, J = 14.5 Hz, 1H), 1.51 (s, 3H), 1.06 (s, 9H);

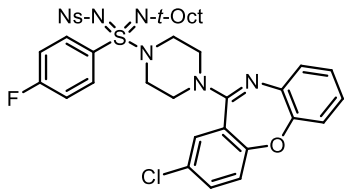
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.0 (d, J = 256.1 Hz), 161.3, 157.8, 149.5, 149.3, 133.7 (d, J = 3.1 Hz), 130.6 (d, J = 9.2 Hz), 127.5, 123.8, 116.1 (d, J = 22.7 Hz), 110.9, 60.3, 57.6, 46.7, 43.6, 32.0, 31.93, 31.87, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, $NC(\boldsymbol{CH_3})_2CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.2 (tt, J = 8.0, 4.8 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1585, 1528, 1486, 1349, 1300, 1260, 1227, 1153, 1086, 1053, 950, 901, 732;

HRMS (ESI^+) calcd. for $C_{28}H_{37}FN_7O_4S_2^+$ $[M+H]^+$: 618.2327, found: 618.2319.

N-((4-(2-Chlorodibenzo[b,f][1,4]oxazepin-11-yl)piperazin-1-yl)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5v)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (238 mg, 0.50 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (332 mg, 0.55 mmol, 1.10 equiv.), *t*-AmylOH (1.0 mL) and Amoxapine (345 mg, 1.10 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 24 h. Purification by flash

column chromatography (petrol/ethyl acetate, 5:1 to 4:1) afforded *sulfondiimidamide* **5v** as a pale-yellow solid (350 mg, 0.46 mmol, 91%).

mp 68-70 °C;

R_f 0.50 (petrol/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.19 (d, J = 8.8 Hz, 2H), 7.85 (d, J = 8.8 Hz, 2H), 7.72 -7.66 (m, 2H), 7.39 (dd, J = 8.6, 2.6 Hz, 1H), 7.23-7.01 (m, 8H), 3.59 (app. br. s, 4H), 3.25 (app. br. s, 4H), 1.74 (d, J = 14.5 Hz, 1H), 1.59 (s, 3H), 1.59 (d, J = 14.5 Hz, 1H), 1.53 (s, 3H), 1.08 (s, 9H);

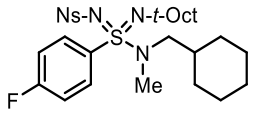
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.1 (d, J = 256.3 Hz), 159.5, 158.6, 151.9, 149.5, 149.3, 139.1, 133.9 (d, J = 2.3 Hz), 133.3, 130.6, 130.5 (d, J = 9.5 Hz), 128.9, 127.5, 127.1, 126.0, 125.6, 124.3, 123.9, 123.1, 120.3, 116.3 (d, J = 22.6 Hz), 60.4, 57.6, 47.6, 46.5, 32.02, 31.96, 31.9, 31.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -104.9 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 2888, 1383, 1251, 1153, 1086, 954;

HRMS (ESI^+) calcd. for $C_{37}H_{41}ClFN_6O_5S_2^+$ $[M+H]^+$: 767.2247, found: 767.2237.

_N_-(((Cyclohexylmethyl)(methyl)amino)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5w)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (153 mg, 0.32 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (213 mg, 0.36 mmol, 1.10 equiv.), *t*-AmylOH (0.65 mL) and 1-cyclohexyl-*N*-methylmethanamine (90 mg, 0.71 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 36 h. Purification by flash column chromatography (petrol/ethyl acetate, 5:1 to 4:1) afforded *sulfondiimidamide* **5w** as a pale-yellow solid (180 mg, 0.31 mmol, 96%).

mp 87-89 °C;

R_f 0.67 (petrol/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.17 (d, *J* = 8.8 Hz, 2H), 7.77 (d, *J* = 8.8 Hz, 2H), 7.70-7.64 (m, 2H), 7.06-6.98 (m, 2H), 3.32 (dd, *J* = 13.0, 8.0 Hz, 1H), 2.87 (dd, *J* = 13.0, 6.4 Hz, 1H), 2.56 (s, 3H), 1.77-1.61 (m, 6H), 1.59-1.51 (m, 1H), 1.57 (d, *J* = 14.5 Hz, 1H), 1.54 (s, 3H), 1.46 (s, 3H), 1.26-1.12 (m, 3H), 1.05 (s, 9H), 0.95-0.83 (m, 2H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.8 (d, *J* = 255.4 Hz), 149.9, 149.2, 135.4 (d, *J* = 3.2 Hz), 130.7 (d, *J* = 9.2 Hz), 127.3, 123.7, 115.9 (d, *J* = 22.6 Hz), 59.9, 58.9, 57.6, 37.0, 34.7, 31.93, 31.90, 31.88, 31.7, 31.3, 31.0, 26.4, 25.9, 25.8;

Notes:

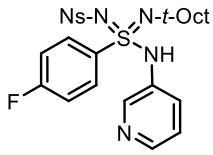
1. For *gem*-dimethyl carbons in *tert*-octyl group, $NC\boldsymbol{(CH_3)_2}CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);
2. For 5 secondary carbons in cyclohexane ring, 5 peaks were found instead of 3 due to the loss of symmetry caused by chiral sulfur atom;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -106.0 (tt, *J* = 8.1, 5.0 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 1528, 1349, 1230, 1152, 1088, 1051;

HRMS (ESI^+) calcd. for $C_{28}H_{41}FN_4O_4S_2Na^+$ $[M+Na]^+$: 603.2445, found: 603.2435.

_N_-((4-Fluorophenyl)(pyridin-3-ylamino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5x)



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (146 mg, 0.31 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (205 mg, 0.34 mmol, 1.10 equiv.), *t*-AmylOH (0.62 mL) and 3-aminopyridine (64 mg, 0.68 mmol, 2.20 equiv.). The reaction was stirred at 60 °C for 30 h. Purification by flash column chromatography (petrol/ethyl acetate, 1:1) afforded *sulfondiimidamide* **5x** as a pale-yellow oil (136 mg, 0.25 mmol, 81%).

R$_f$ 0.25 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.47 (dd, *J* = 2.7, 0.7 Hz, 1H), 8.23-8.18 (m, 2H), 8.15 (dd, *J* = 4.8, 1.4 Hz, 1H), 7.97 (d, *J* = 8.9 Hz, 2H), 7.82 (d, *J* = 8.9 Hz, 2H), 7.44 (ddd, *J* = 8.2, 2.7, 1.4 Hz, 1H), 7.23-7.16 (m, 2H), 7.09 (ddd, *J* = 8.2, 4.8, 0.7 Hz, 1H), 6.11 (br. s, 1H), 1.41 (d, *J* = 15.0 Hz, 1H), 1.37 (d, *J* = 15.0 Hz, 1H), 1.16 (s, 3H), 1.10 (s, 3H), 0.85 (s, 9H);

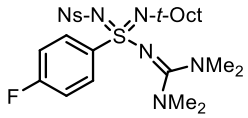
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.7 (d, *J* = 258.0 Hz), 149.5, 148.0, 143.5, 142.0, 140.2, 136.2 (d, *J* = 3.3 Hz), 131.6 (d, *J* = 9.5 Hz), 130.9, 128.2, 123.9, 123.6, 116.7 (d, *J* = 22.8 Hz), 61.6, 56.5, 31.6, 31.5, 29.3, 28.7 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -103.1 (tt, *J* = 8.0, 4.8 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1305, 1235, 1156, 1087, 733;

HRMS (ESI^+) calcd. for $C_{25}H_{31}FN_5O_4S_2^+$ $[M+H]^+$: 548.1796, found: 548.1792.

***N*-(((Bis(dimethylamino)methylene)amino)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5y)**



Prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (132 mg, 0.28 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (184 mg, 0.31 mmol, 1.10 equiv.), *t*-AmylOH (0.70 mL) and 1,1,3,3-tetramethylguanidine (97 mg, 0.84 mmol, 3.00 equiv.). The reaction was stirred at 80 °C for 24 h. Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1 to 1:3) afforded *sulfondiimidamide* **5y** as a colourless oil (135 mg, 0.24 mmol, 85%).

R$_f$ 0.50 (petrol/ethyl acetate, 1:2);

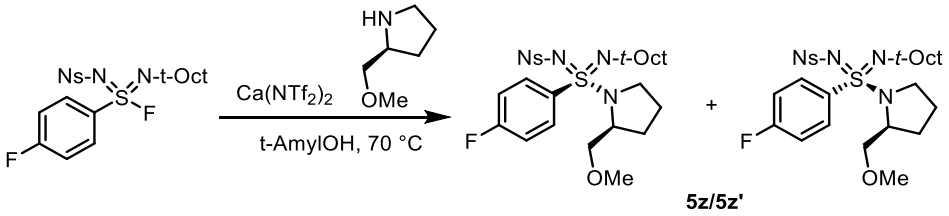
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.12 (d, *J* = 8.9 Hz, 2H), 7.91-7.84 (m, 4H), 6.94-6.87 (m, 2H), 2.91 (s, 12H), 1.43 (d, *J* = 14.4 Hz, 1H), 1.34 (d, *J* = 14.4 Hz, 1H), 1.27 (s, 3H), 1.20 (s, 3H), 0.83 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 163.8 (d, J = 252.6 Hz), 161.5, 151.4, 148.7, 143.8 (d, J = 2.5 Hz), 129.0 (d, J = 8.8 Hz), 127.6, 123.3, 114.9 (d, J = 22.3 Hz), 59.3, 57.8, 41.1, 31.8, 31.7, 31.6, 31.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, $NC(\boldsymbol{CH_3})_2CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -108.6 (tt, J = 8.6, 5.2 Hz);

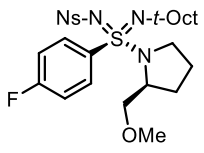
IR (ATR): $\tilde{\nu}$ (cm^{-1}) =1521, 1396, 1348, 1218, 1143, 1088, 1039, 729;

HRMS (ESI^+) calcd. for $C_{25}H_{38}FN_6O_4S_2^+$ $[M+H]^+$: 569.2374, found: 569.2370.

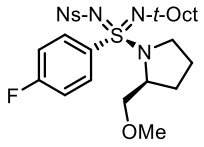


Sulfondiimidamides **5z** and **5z'** were prepared according to **General Procedure C** using sulfondiimidoyl fluoride **4a** (380 mg, 0.80 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (530 mg, 0.88 mmol, 1.10 equiv.), *t*-AmylOH (1.60 mL) and (*S*)-(+)-2-(methoxymethyl)pyrrolidine (203 mg, 1.76 mmol, 2.20 equiv.). The reaction was stirred at 70 °C for 36 h. Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 20:1 to 15:1) afforded *diastereoisomer* **5z** as a white solid (204 mg, 0.36 mmol, 45%) and *diastereoisomer* **5z'** as a colourless oil (206 mg, 0.36 mmol, 45%). (Sulfur stereochemistry of these two compounds remains unknown)

***N*-((*R*)-(4-Fluorophenyl)((*S*)-2-(methoxymethyl)pyrrolidin-1-yl)((2,4,4-trimethylpentan-2-yl)imino)- λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide**



***N*-((*S*)-(4-Fluorophenyl)((*S*)-2-(methoxymethyl)pyrrolidin-1-yl)((2,4,4-trimethylpentan-2-yl)imino)- λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide**



Diastereoisomer 1 (Sulfur stereochemistry is unknown)

mp 108-110 °C;

R_f 0.60 (CH_2Cl_2/ethyl acetate, 15:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.08 (d, J = 8.8 Hz, 2H), 7.82-7.75 (m, 2H), 7.54 (d, J = 8.8 Hz, 2H), 7.03-6.96 (m, 2H), 4.32 (ddt, J = 8.0, 5.5, 2.8 Hz, 1H), 3.47 (dd, J = 9.3, 5.4 Hz, 1H), 3.34 (dd, J = 9.3, 2.6 Hz, 1H), 3.23-3.15 (m, 1H), 3.20 (s, 3H), 2.73-2.67 (m, 1H), 2.03-1.82 (m, 4H), 1.68 (d, J = 14.5 Hz, 1H), 1.62 (s, 3H), 1.58 (d, J = 14.5 Hz, 1H), 1.49 (s, 3H), 1.04 (s, 9H);

^{13}C NMR (101 MHz, $(CD_3)_2CO$): δ (ppm) = 165.7 (d, J = 252.7 Hz), 150.8, 150.0, 137.0 (d, J = 2.9 Hz), 132.5 (d, J = 9.5 Hz), 128.0, 124.5, 116.5 (d, J = 23.0 Hz), 75.3, 61.0, 59.9, 59.0, 58.1, 46.9, 32.6, 32.4, 32.3, 32.2, 29.7, 24.7 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -106.1 (tt, J = 8.0, 5.0 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) =1718, 1529, 1489, 1349, 1300, 1228, 1155, 1088, 1052, 1030, 997;

HRMS (ESI^+) calcd. for $C_{26}H_{38}FN_4O_5S_2^+$ $[M+H]^+$: 569.2262, found: 569.2264;

$[\alpha]_D^{25}$: -126.4° (c = 1.0, $CHCl_3$).

Diastereoisomer 2 (Sulfur stereochemistry is unknown)

R_f 0.46 (CH_2Cl_2/ethyl acetate, 15:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.14 (d, J = 8.8 Hz, 2H), 7.77 (d, J = 8.8 Hz, 2H), 7.69-7.63 (m, 2H), 7.00-6.94 (m, 2H), 4.14 (tt, J = 7.2, 3.6 Hz, 1H), 3.57 (dd, J = 9.2, 3.3 Hz, 1H), 3.38 (dd, J = 9.2, 6.8 Hz, 1H), 3.28 (s, 3H), 3.17-3.10 (m, 1H), 3.00-2.93 (m, 1H), 1.93-1.78 (m, 3H), 1.67 (d, J = 14.5 Hz, 1H), 1.56 (s, 3H), 1.55 (d, J = 14.5 Hz, 1H), 1.47 (s, 3H), 1.46-1.39 (m, 1H), 1.03 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.7 (d, *J* = 255.4 Hz), 149.9, 149.1, 136.3 (d, *J* = 3.1 Hz), 130.4 (d, *J* = 9.2 Hz), 127.3, 123.7, 115.8 (d, *J* = 22.6 Hz), 75.4, 62.9, 60.1, 59.0, 57.5, 47.7, 31.9, 31.8, 31.4, 31.3, 28.8, 24.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

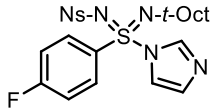
^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.9 (tt, *J* = 8.0, 5.0 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1589, 1529, 1489, 1350, 1300, 1229, 1154, 1089, 1056, 1030;

HRMS (ESI^+) calcd. for $C_{26}H_{38}FN_4O_5S_2^+$ $[M+H]^+$: 569.2262, found: 569.2256;

$[\alpha]_D^{25}$: +17.0° (c = 1.0, $CHCl_3$).

_N_-((4-Fluorophenyl)(1*H*-imidazol-1-yl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5aa)



Sulfondiimidoyl fluoride **4a** (735 mg, 1.55 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (1.02 g, 1.71 mmol, 1.10 equiv.) and imidazole (633 mg, 9.30 mmol, 6.0 equiv.) were added in an oven-dried 25 mL round-bottom flask and dissolved in anhydrous *t*-AmylOH (3.10 mL). The reaction was sealed and stirred at 65 °C for 12 h. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 4:1 to 2:1 to 1:2) without an aqueous workup to afford *sulfondiimidamide* **5aa** as a white solid (710 mg, 1.36 mmol, 88%).

Note:

Continuous monitoring of this reaction is important as the desired product tends to hydrolyse under this reaction conditions. 12 h seems to maximise the yield with only around 5% of hydrolysed product (shown in ^{19}F NMR). Extended reaction times led to larger amounts of hydrolysed product.

mp 160-162 °C;

R_f 0.62 (petrol/ethyl acetate, 1:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.20 (d, *J* = 9.0 Hz, 2H), 8.04 (t, *J* = 1.1 Hz, 1H), 7.77 (d, *J* = 9.0 Hz, 2H), 7.61-7.57 (m, 2H), 7.13 (t, *J* = 1.5 Hz, 1H), 7.09-7.03 (m, 3H), 1.76 (d, *J* = 14.8 Hz, 1H), 1.62 (s, 3H), 1.59 (d, *J* = 14.8 Hz, 1H), 1.33 (s, 3H), 1.08 (s, 9H);

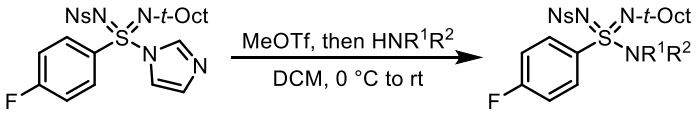
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.7 (d, *J* = 259.3 Hz), 149.8, 148.3, 137.9, 135.1 (d, *J* = 3.2 Hz), 131.6, 130.3 (d, *J* = 9.8 Hz), 127.5, 124.1, 117.6, 116.8 (d, *J* = 23.1 Hz), 63.1, 57.2, 31.9, 31.8, 31.3, 30.9 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -101.7 (tt, *J* = 7.7, 4.8 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1530, 1350, 1305, 1158, 1085, 1024, 735;

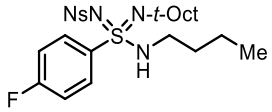
HRMS (ESI^+) calcd. for $C_{23}H_{28}FN_5O_4S_2Na^+$ $[M+Na]^+$: 544.1459, found: 544.1461.

2.2.5 General Procedure D for Sulfondiimidamide Synthesis



An oven-dried round-bottom flask containing sulfondiimidamide **5aa** (1.00 equiv.) was sealed and subjected to three N_2 evacuation/refill cycles before anhydrous CH_2Cl_2 (0.3 M) was added. The solution was cooled to 0 °C before MeOTf (1.05 equiv.) was added. The reaction was warmed to room temperature and stirred for 30 min. Then amine (2.10 equiv.) was added and the reaction was stirred at room temperature for another 30 min before being quenched with sat. aq. NaCl solution. CH_2Cl_2 was added and the organic layer was separated. The aqueous layers was extracted with CH_2Cl_2 twice. The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by flash column chromatography to afford the desire sulfondiimidamide.

***N*-((Butylamino)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5ab)**



An oven-dried 10 mL round-bottom flask containing sulfondiimidamide **5aa** (107 mg, 0.21 mmol, 1.00 equiv.) was sealed and subjected to three N_2 evacuation/refill cycles before anhydrous CH_2Cl_2 (0.70 mL) was added. The solution was cooled to 0 °C before MeOTf (25 μL, 0.22 mmol, 1.05 equiv.) was added. The reaction was warmed to room temperature and stirred for 30 min. Then *n*-butyl amine (32 mg, 0.43 mmol, 2.10 equiv.) was added and the reaction was stirred at room temperature for another 30 min before being quenched with sat. aq. NaCl solution (50 mL). CH_2Cl_2 (20 mL) was added and the organic layer was separated. The aqueous layers was extracted with CH_2Cl_2 (2 × 20 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 3:1) to afford *sulfondiimidamide* **5ab** as a white solid (105 mg, 0.20 mmol, 97%).

mp 81-83 °C;

R$_f$ 0.63 (petrol/ethyl acetate, 2:1);

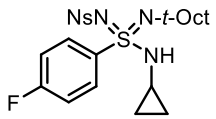
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.13 (d, J = 8.9 Hz, 2H), 7.85-7.78 (m, 4H), 7.03- 6.97 (m, 2H), 6.10-5.30 (br. s, 1H), 2.98 (dt, J = 12.2, 7.3 Hz, 1H), 2.64 (dt, J = 12.2, 7.3 Hz, 1H), 1.64 (d, J = 14.5 Hz, 1H), 1.56-1.43 (m, 9H), 1.33-1.23 (m, 2H), 1.02 (s, 9H), 0.84 (t, J = 7.3 Hz, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.9 (d, J = 255.9 Hz), 149.3, 149.2, 135.4 (d, J = 2.0 Hz), 130.7 (d, J = 9.2 Hz), 127.7, 123.7, 116.0 (d, J = 22.7 Hz), 60.2, 57.6, 41.6, 31.87, 31.86, 31.6, 31.5, 31.3, 20.1, 13.7 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.5 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1348, 1290, 1268, 1233, 1146, 1091, 1025, 1006, 731;
HRMS (ESI^+) calcd. for $C_{24}H_{36}FN_4O_4S_2^+$ $[M+H]^+$: 527.2157, found: 527.2156.

_N_-((Cyclopropylamino)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5ac)



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (98 mg, 0.19 mmol, 1.00 equiv.), CH_2Cl_2 (0.62 mL), MeOTf (22 µL, 0.20 mmol, 1.05 equiv.) and cyclopropylamine (23 mg, 0.39 mmol, 2.10 equiv.). Purification by flash column chromatography (petrol/ethyl acetate, 3:1) afforded *sulfondiimidamide* **5ac** as a pale-yellow solid (89 mg, 0.17 mmol, 93%).

mp 88-90 °C;

R$_f$ 0.50 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.18 (d, J = 8.8 Hz, 2H), 7.93-7.87 (m, 2H), 7.85 (d, J = 8.8 Hz, 2H), 7.09-7.02 (m, 2H), 6.40-5.12 (br. s, 1H), 2.47 (app. br. s, 1H), 1.66 (d, J = 14.7 Hz, 1H), 1.58 (d, J = 14.7 Hz, 1H), 1.50 (s, 3H), 1.46 (s, 3H), 1.03 (s, 9H), 0.66-0.53 (m, 2H), 0.50-0.41 (m, 1H), 0.27 (app. br. s, 1H);

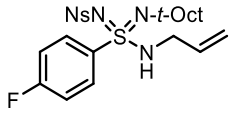
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.0 (d, J = 256.0 Hz), 149.4, 149.0, 136.2 (d, J = 2.0 Hz), 131.0 (d, J = 9.3 Hz), 127.7, 123.7, 115.9 (d, J = 22.7 Hz), 60.3, 57.3, 31.88, 31.85, 31.2, 25.0, 6.3, 1.1 (note: or 2 secondary carbons in cyclopropane ring, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.3 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 1383, 1252, 1149, 1088, 955;

HRMS (ESI^+) calcd. for $C_{23}H_{31}FN_4O_4S_2Na^+$ $[M+Na]^+$: 533.1663, found: 533.1656.

N-((Allylamino)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5ad)



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (96 mg, 0.18 mmol, 1.00 equiv.), CH_2Cl_2 (0.60 mL), MeOTf (22 μL, 0.19 mmol, 1.05 equiv.) and allylamine (22 mg, 0.39 mmol, 2.10 equiv.). Purification by flash column chromatography (petrol/ethyl acetate, 3:1) afforded *sulfondiimidamide* **5ad** as a white solid (75 mg, 0.15 mmol, 80%).

mp 95-97 °C;

R_f 0.43 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.13 (d, J = 8.9 Hz, 2H), 7.88-7.78 (m, 2H), 7.81 (d, J = 8.9 Hz, 2H), 7.05-6.98 (m, 2H), 6.15-5.50 (m, 2H), 5.22 (d, J = 17.0 Hz, 1H), 5.14 (dd, J = 10.3, 1.3 Hz, 1H), 3.74-3.57 (m, 1H), 3.35 (app. br. s, 1H), 1.67-1.37 (m, 8H), 1.01 (s, 9H);

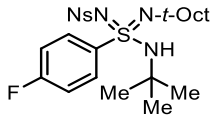
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.0 (d, J = 256.1 Hz), 149.3, 149.2, 135.5, 132.6, 130.7 (d, J = 9.3 Hz), 127.7, 123.7, 118.1, 116.1 (d, J = 22.7 Hz), 60.4, 57.5, 44.3, 31.9, 31.8, 31.2;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.1 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 1528, 1349, 1230, 1148, 1088, 1004, 731;

HRMS (ESI^+) calcd. for $C_{23}H_{31}FN_4O_4S_2Na^+$ $[M+Na]^+$: 533.1663, found: 533.1660.

***N*-((*tert*-Butylamino)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5ae)**



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (97 mg, 0.19 mmol, 1.00 equiv.), CH_2Cl_2 (0.62 mL), MeOTf (22 µL, 0.20 mmol, 1.05 equiv.) and *tert*-butylamine (29 mg, 0.39 mmol, 2.10 equiv.). Purification by flash column chromatography (petrol/ethyl acetate, 3:1) afforded *sulfondiimidamide* **5ae** as a white solid (80 mg, 0.15 mmol, 82%).

mp 106-108 °C;

R$_f$ 0.50 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.22 (d, J = 8.8 Hz, 2H), 7.98-7.94 (m, 2H), 7.90 (d, J = 8.8 Hz, 2H), 7.08-7.03 (m, 2H), 6.50-5.50 (br. s, 1H), 1.66-1.57 (m, 2H), 1.48-1.23 (m, 15H), 1.00 (s, 9H);

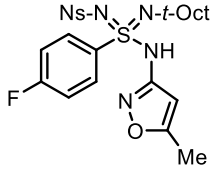
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.9 (d, J = 255.5 Hz), 149.6, 149.4, 140.2, 130.6 (d, J = 9.3 Hz), 127.5, 123.9, 115.9 (d, J = 22.6 Hz), 60.8, 57.3, 56.4, 31.9, 31.8, 31.1, 30.6;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -106.4 (tt, J = 8.2, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) =1531, 1348, 1286, 1227, 1144, 1091, 1045, 965, 744;

HRMS (ESI^+) calcd. for $C_{24}H_{35}FN_4O_4S_2Na^+$ $[M+Na]^+$: 549.1976, found: 549.1974.

***N*-((4-Fluorophenyl)((5-methylisoxazol-3-yl)amino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5af)**



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (113 mg, 0.22 mmol, 1.00 equiv.), CH_2Cl_2 (0.72 mL), MeOTf (26 µL, 0.23 mmol, 1.05 equiv.) and a solution of 3-amino-5-methylisoxazole (45 mg, 0.46 mmol, 2.10 equiv) in CH_2Cl_2 (0.72 mL). Purification by flash column

chromatography (petrol/ethyl acetate, 3:1) afforded *sulfondiimidamide* **5af** as a white solid (98 mg, 0.18 mmol, 82%).

mp 132-134 °C;

R_f 0.33 (petrol/ethyl acetate, 3:1);

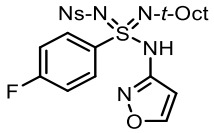
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.25-8.18 (m, 2H), 8.10 (d, J = 8.9 Hz, 2H), 7.92 (d, J = 8.9 Hz, 2H), 7.26-7.19 (m, 2H), 5.58 (d, J = 0.9 Hz, 1H), 5.53 (br. s, 1H), 2.21 (d, J = 0.9 Hz, 3H), 1.47 (d, J = 14.9 Hz, 1H), 1.41 (d, J = 14.9 Hz, 1H), 1.22 (s, 3H), 1.14 (s, 3H), 0.93 (s, 9H);
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 169.4, 165.8 (d, J = 257.9 Hz), 160.9, 149.5, 148.3, 135.9 (d, J = 3.2 Hz), 131.7 (d, J = 9.5 Hz), 128.4, 123.5, 116.7 (d, J = 22.9 Hz), 98.5, 62.0, 56.6, 31.7, 31.6, 29.3, 28.6, 12.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -103.1 (tt, J = 8.6, 4.8 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 2888, 1383, 1251, 1154, 1089, 955;

HRMS (ESI^+) calcd. for $C_{24}H_{31}FN_5O_5S_2^+$ $[M+H]^+$: 552.1745, found:552.1736.

N-((4-Fluorophenyl)(isoxazol-3-ylamino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5ag)



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (162 mg, 0.31 mmol, 1.00 equiv.), CH_2Cl_2 (1.03 mL), MeOTf (37 µL, 0.33 mmol, 1.05 equiv.) and 3-aminoisoxazole (55 mg, 0.65 mmol, 2.10 equiv.). Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 2:1) afforded *sulfondiimidamide* **5ag** as a white solid (158 mg, 0.29 mmol, 95%).

mp 118-120 °C;

R_f 0.50 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.25-8.19 (m, 2H), 8.09 (d, J = 8.8 Hz, 2H), 8.05 (d, J = 1.7 Hz, 1H), 7.91 (d, J = 8.8 Hz, 2H), 7.25-7.19 (m, 2H), 6.01 (d, J = 1.6 Hz, 1H), 5.66 (s, 1H), 1.45 (d, J = 14.9 Hz, 1H), 1.40 (d, J = 14.9 Hz, 1H), 1.19 (s, 3H), 1.13 (s, 3H), 0.90 (s, 9H);

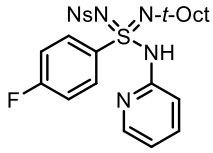
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.8 (d, J = 258.0 Hz), 160.3, 158.6, 149.6, 148.1, 135.7 (d, J = 3.2 Hz), 131.7 (d, J = 9.6 Hz), 128.3, 123.5, 116.7 (d, J = 22.9 Hz), 101.6, 62.0, 56.4, 31.6, 31.5, 29.1, 28.7 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -102.9 (tt, J = 8.1, 4.1 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1561, 1529, 1462, 1350, 1301, 1154, 1090, 1062, 977, 741;

HRMS (ESI^+) calcd. for $C_{23}H_{29}FN_5O_5S_2^+$ $[M+H]^+$: 538.1589, found: 538.1580.

***N*-((4-Fluorophenyl)(pyridin-2-ylamino)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5ah)**



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (156 mg, 0.30 mmol, 1.00 equiv.), CH_2Cl_2 (1.0 mL), MeOTf (36 µL, 0.32 mmol, 1.05 equiv.) and a solution of 2-aminopyridine (59 mg, 0.63 mmol, 2.10 equiv) in CH_2Cl_2 (1.0 mL). Purification by flash column chromatography (petrol/ethyl acetate, 1:1) afforded *sulfondiimidamide* **5ah** as a white solid (160 mg, 0.29 mmol, 98%).

mp 128-130 °C;

R$_f$ 0.50 (petrol/ethyl acetate, 1:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.54-6.42 (br. s, 1H), 8.22-8.16 (m, 2H), 7.98 (d, J = 8.9 Hz, 2H), 7.92-7.82 (m, 3H), 7.39 (ddd, J = 8.2, 7.3, 2.0 Hz, 1H), 7.22-7.15 (m, 2H), 6.72 (ddd, J = 7.3, 5.1, 1.0 Hz, 1H), 6.62 (dt, J = 8.2, 1.0 Hz, 1H), 1.48 (s, 2H), 1.25 (s, 3H), 1.18 (s, 3H), 0.95 (s, 9H);

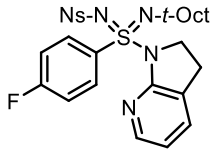
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.5 (d, J = 256.8 Hz), 157.3, 149.2, 149.1, 146.3, 138.2, 137.6 (d, J = 2.8 Hz), 131.4 (d, J = 9.5 Hz), 128.2, 123.3, 118.0, 117.0, 116.4 (d, J = 22.9 Hz), 61.6, 56.9, 31.7, 31.6, 29.4, 29.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -103.9 (tt, J = 8.2, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1589, 1527, 1348, 1299, 1232, 1149, 1087, 1029, 1008, 732;

HRMS (ESI^+) calcd. for $C_{25}H_{31}FN_5O_4S_2^+$ $[M+H]^+$: 548.1796, found: 548.1793.

_N_-((2,3-Dihydro-1_H_-pyrrolo[2,3-_b_]pyridin-1-yl)(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5ai)



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (93 mg, 0.18 mmol, 1.00 equiv.), CH_2Cl_2 (0.60 mL), MeOTf (21 µL, 0.19 mmol, 1.05 equiv.) and a solution of 2,3-dihydro-7-azaindole (45 mg, 0.38 mmol, 2.10 equiv) in CH_2Cl_2 (0.60 mL). Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) afforded *sulfondiimidamide* **5ai** as a white solid (88 mg, 0.15 mmol, 85%).

mp 118-120 °C;

R$_f$ 0.40 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.09 (d, J = 8.8 Hz, 2H), 7.83-7.78 (m, 2H), 7.74 (ddd, J = 5.2, 1.8, 0.9 Hz, 1H), 7.70 (d, J = 8.8 Hz, 2H), 7.34 (dq, J = 7.3, 1.3 Hz, 1H), 6.96-6.89 (m, 2H), 6.69 (dd, J = 7.3, 5.2 Hz, 1H), 4.51 (td, J = 10.5, 6.5 Hz, 1H), 4.26 (td, J = 10.5, 7.3 Hz, 1H), 3.21-3.01 (m, 2H), 1.63 (d, J = 14.5 Hz, 1H), 1.57 (s, 3H), 1.49 (d, J = 14.5 Hz, 1H), 1.35 (s, 3H), 1.02 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.8 (d, J = 255.3 Hz), 156.3, 149.8, 149.1, 146.5, 136.6 (d, J = 3.1 Hz), 133.1, 130.9 (d, J = 9.2 Hz), 127.4, 124.4, 123.6, 117.7, 115.5 (d, J = 23.0 Hz), 60.7,

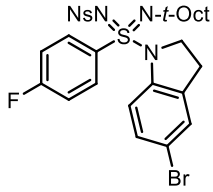
57.2, 51.0, 31.83, 31.81, 31.75, 31.4, 25.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***CH$_2$C(CH$_3$)$_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.8 (tt, J = 8.1, 5.0 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1415, 1349, 1301, 1230, 1152, 1088, 1043, 949, 736;

HRMS (ESI^+) calcd. for $C_{27}H_{33}FN_5O_4S_2^+$ $[M+H]^+$: 574.1953, found: 574.1946.

N-((4-Fluorophenyl)(1H-indol-1-yl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5aj)



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (313 mg, 0.60 mmol, 1.00 equiv.), CH_2Cl_2 (2.00 mL), MeOTf (71 µL, 0.65 mmol, 1.05 equiv.) and a solution of 5-bromoindoline (250 mg, 1.26 mmol, 2.10 equiv) in CH_2Cl_2 (2.00 mL). Purification by flash column chromatography (petrol/ethyl acetate, 3:1 to 2:1) afforded *sulfondiimidamide* **5aj** as a colourless oil (319 mg, 0.49 mmol, 82%).

R$_f$ 0.38 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.13-8.06 (m, 2H), 7.71-7.61 (m, 4H), 7.23 (s, 1H), 7.04 (d, J = 8.7 Hz, 1H), 7.00-6.93 (m, 2H), 6.73 (d, J = 8.6 Hz, 1H), 4.40-4.28 (m, 1H), 4.18-4.07 (m, 1H), 3.01 (t, J = 8.6 Hz, 2H), 1.66 (d, J = 14.7 Hz, 1H), 1.63 (s, 3H), 1.54 (d, J = 14.6 Hz, 1H), 1.35 (s, 3H), 1.06 (s, 9H).;

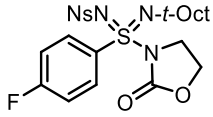
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.1 (d, J = 256.8 Hz), 149.4, 149.2, 140.8, 135.2 (d, J = 3.2 Hz), 134.4, 130.7 (d, J = 9.3 Hz), 130.1, 128.5, 127.3, 123.7, 116.2 (d, J = 22.7 Hz), 116.0, 115.9, 61.0, 57.2, 52.8, 31.89, 31.85, 31.7, 31.4, 27.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***CH$_2$C(CH$_3$)$_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -104.2 (tt, J = 7.8, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1591, 1529, 1469, 1349, 1304, 1235, 1154, 1088, 1044;

HRMS (ESI^+) calcd. for $C_{28}H_{33}{}^{79}BrFN_4O_4S_2^+$ $[M+H]^+$: 651.1105, found: 651.1104; calcd. for $C_{28}H_{33}{}^{81}BrFN_4O_4S_2^+$ $[M+H]^+$: 653.1086, found: 653.1079.

_N_-((4-Fluorophenyl)(2-oxooxazolidin-3-yl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5ak)



Prepared according to **General Procedure D** using sulfondiimidamide **5aa** (156 mg, 0.30 mmol, 1.00 equiv.), CH_2Cl_2 (1.00 mL), MeOTf (36 µL, 0.31 mmol, 1.05 equiv.) and 2-oxazolidinone (55 mg, 0.63 mmol, 2.10 equiv.). The reaction was stirred at room temperature for 2 h. Purification by flash column chromatography (petrol/ethyl acetate, 2:1 to 1:1) afforded *sulfondiimidamide* **5ak** as a colourless oil (141 mg, 0.26 mmol, 87%).

R$_f$ 0.41 (petrol/ethyl acetate, 1:1);

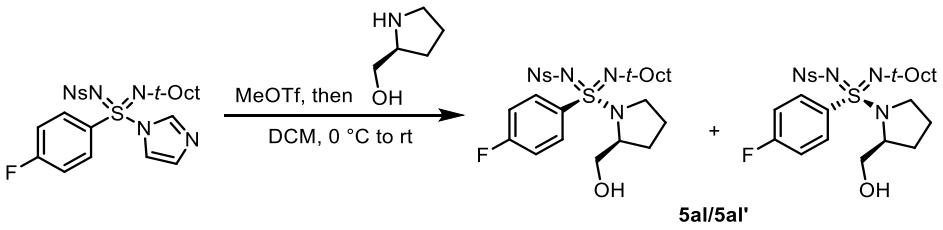
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.20 (d, J = 9.0 Hz, 2H), 7.86 (d, J = 9.0 Hz, 2H), 7.85-7.80 (m, 2H), 7.08-7.02 (m, 2H), 4.36-4.28 (m, 3H), 4.21-4.12 (m, 1H), 1.73 (d, J = 14.5 Hz, 1H), 1.65 (d, J = 14.5 Hz, 1H), 1.58 (s, 3H), 1.52 (s, 3H), 1.07 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.5 (d, J = 257.5 Hz), 151.9, 149.6, 148.8, 135.4 (d, J = 3.1 Hz), 131.0 (d, J = 9.7 Hz), 127.6, 124.0, 116.3 (d, J = 23.0 Hz), 62.2, 61.8, 57.0, 47.4, 31.9, 31.8, 31.7, 31.4 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -103.5 (tt, J = 8.0, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1773, 1529, 1349, 1303, 1154, 1123, 1086, 1031, 1004, 837, 728, 647;

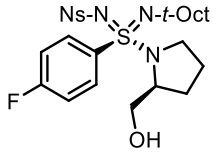
HRMS (ESI^+) calcd. for $C_{23}H_{29}FN_4O_6S_2Na^+$ $[M+Na]^+$: 563.1405, found: 563.1406.



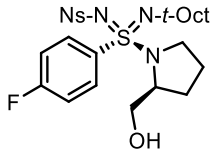
5al/5al'

Sulfondiimidamides **5al** and **5al'** were prepared according to **General Procedure D** using sulfondiimidamide **5aa** (300 mg, 0.58 mmol, 1.00 equiv.), CH_2Cl_2 (1.9 mL), MeOTf (69 μL, 0.61 mmol, 1.05 equiv.) and (*S*)-(+)-2-pyrrolidinemethanol (123 mg, 1.22 mmol, 2.10 equiv.). The reaction was stirred at room temperature for 1 h. Purification by flash column chromatography (CH_2Cl_2/ethyl acetate, 3:1) afforded *diastereoisomer* **5al** as a white solid (132 mg, 0.24 mmol, 41%) and *diastereoisomer* **5al'** as a white solid (133 mg, 0.24 mmol, 41%). (Sulfur stereochemistry of these two compounds remains unknown)

***N*-((*R*)-(4-Fluorophenyl)((*S*)-2-(hydroxymethyl)pyrrolidin-1-yl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide**



***N*-((*S*)-(4-Fluorophenyl)((*S*)-2-(hydroxymethyl)pyrrolidin-1-yl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide**



Diastereoisomer 1 (Sulfur stereochemistry is unknown)

mp 44-46 °C;

R$_f$ 0.53 (CH_2Cl_2/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.15 (d, *J* = 8.9 Hz, 2H), 7.83-7.78 (m, 2H), 7.75 (d, *J* = 8.9 Hz, 2H), 7.07-7.02 (m, 2H), 4.38 (tt, *J* = 8.4, 3.8 Hz, 1H), 3.84-3.04 (br. s, 1H), 3.77 (dd, *J* = 11.0, 4.3 Hz, 1H), 3.58 (dd, *J* = 11.0, 5.3 Hz, 1H), 3.05 (dt, *J* = 10.0, 7.0 Hz, 1H), 2.75 (ddd, *J* = 10.0, 7.0, 5.1 Hz, 1H), 2.04-1.93 (m, 1H), 1.92-1.80 (m, 2H), 1.76-1.67 (m, 1H), 1.65 (d,

J = 14.5 Hz, 1H), 1.57 (d, *J* = 14.5 Hz, 1H), 1.48 (s, 3H), 1.46 (s, 3H), 1.00 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.0 (d, *J* = 256.1 Hz), 149.4, 149.3, 136.8 (d, *J* = 3.1 Hz), 131.2 (d, *J* = 9.2 Hz), 127.4, 123.8, 116.2 (d, *J* = 22.6 Hz), 65.9, 62.8, 60.3, 57.7, 46.7, 32.2, 31.9, 31.8, 31.5, 28.9, 24.5 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -105.3 (tt, *J* = 8.5, 5.1 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1383, 1349, 1298, 1234, 1152, 1086, 1051, 969;

HRMS (ESI^+) calcd. for $C_{25}H_{36}FN_4O_5S_2^+$ $[M+H]^+$: 555.2106, found: 555.2097;

$[\alpha]_D^{25}$: -76.0° (c = 1.0, $CHCl_3$).

Diastereoisomer 2 (Sulfur stereochemistry is unknown)

mp 117-120 °C;

R$_f$ 0.47 (CH_2Cl_2/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.20 (d, *J* = 8.8 Hz, 2H), 7.87 (d, *J* = 8.8 Hz, 2H), 7.76-7.71 (m, 2H), 7.07-7.01 (m, 2H), 4.30 (tt, *J* = 8.6, 4.5 Hz, 1H), 4.05-3.55 (br. s, 1H), 3.71 (dd, *J* = 10.9, 7.2 Hz, 1H), 3.62 (dd, *J* = 10.9, 4.6 Hz, 1H), 3.12-3.00 (m, 2H), 2.04-1.94 (m, 1H), 1.78 (dt, *J* = 12.0, 6.6 Hz, 1H), 1.72-1.63 (m, 2H), 1.58 (d, *J* = 14.5 Hz, 1H), 1.51 (s, 3H), 1.47 (s, 3H), 1.45-1.36 (m, 1H), 1.03 (s, 9H);

^{13}C NMR (101 MHz, $(CD_3)_2CO$): δ (ppm) = 165.6 (d, *J* = 252.6 Hz), 150.8, 150.0, 136.8 (d, *J* = 3.1 Hz), 131.7 (d, *J* = 9.5 Hz), 128.2, 124.6, 116.5 (d, *J* = 23.0 Hz), 66.6, 65.8, 60.4, 58.2, 48.2, 32.4, 32.3, 32.0, 31.8, 29.0, 24.9 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

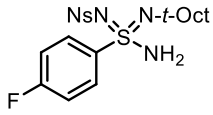
^{19}F NMR (377 MHz, $(CD_3)_2CO$): δ (ppm) = -108.4 (tt, *J* = 8.6, 5.1 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1589, 1529, 1489, 1350, 1299, 1265, 1230, 1152, 1087, 1047, 977;

HRMS (ESI^+) calcd. for $C_{25}H_{36}FN_4O_5S_2^+$ $[M+H]^+$: 555.2106, found: 555.2106;

$[\alpha]_D^{25}$: +37.5° (c = 1.0, $CHCl_3$).

***N*-(Amino(4-fluorophenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (5am)**



An oven-dried 10 mL round-bottom flask containing sulfondiimidamide **5aa** (167 mg, 0.32 mmol, 1.00 equiv.) was sealed and subjected to three N_2 evacuation/refill cycles before anhydrous CH_2Cl_2 (1.07 mL) was added. The solution was cooled to 0 °C before MeOTf (38 μL, 0.34 mmol, 1.05 equiv.) was added. The reaction was warmed to room temperature and was stirred for 30 min. Then ammonia solution (0.64 mL, 2 M in *i*-PrOH, 1.28 mmol, 4.00 equiv.) was added and the reaction was stirred at room temperature for another 30 min. The reaction was then concentrated under reduced pressure and crude product was purified by flash column chromatography (petrol/ethyl acetate, 3:1 to 1:1) to afford *sulfondiimidamide* **5am** as a white solid (108 mg, 0.23 mmol, 72%).

mp 93-95 °C;

R$_f$ 0.33 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) =8.16 (d, J = 8.9 Hz, 2H), 8.03-7.98 (m, 2H), 7.94 (d, J = 8.9 Hz, 2H), 7.11-7.04 (m, 2H), 5.66-4.75 (br. s, 1H), 3.85-2.88 (br. s, 1H), 1.56 (d, J = 14.9 Hz, 1H), 1.44 (d, J = 14.9 Hz, 1H), 1.31 (s, 3H), 1.15 (s, 3H), 0.96 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.3 (d, J = 256.8 Hz), 149.5, 149.3, 137.4, 130.4 (d, J = 9.4 Hz), 128.0, 123.8, 116.2 (d, J = 22.7 Hz), 61.0, 56.4, 31.71, 31.70, 29.8, 28.9 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

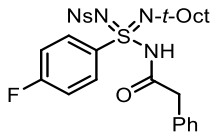
^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -104.4 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1281, 1153, 1096, 1059, 991, 962;

HRMS (ESI^+) calcd. for $C_{20}H_{27}FN_4O_4S_2Na^+$ $[M+Na]^+$: 493.1350, found: 493.1350.

2.2.6 Functionalisation of Primary Sulfondiimidamide 5am

N-((4-Fluorophenyl)(phenylacetamido)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (6a)



To an oven-dried 25 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **5am** (180 mg, 0.38 mmol, 1.00 equiv.) in anhydrous CH_2Cl_2 (2.5 mL) at room temperature. Et_3N (80 μL, 0.57 mmol, 1.50 equiv.) was then added, followed by the addition of phenylacetyl chloride (70 mg, 0.46 mmol, 1.20 equiv.). After being stirred at room temperature for 30 min, the reaction mixture was quenched with sat. aq. NaCl solution (100 mL). The product was extracted with CH_2Cl_2 (3 × 40 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 3:1 to 2:1) to afford *sulfondiimidamide* **6a** as a white solid (158 mg, 0.27 mmol, 70%).

mp 78-80 °C;

R$_f$ 0.50 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.13 (d, *J* = 8.9 Hz, 2H), 7.95 (d, *J* = 8.9 Hz, 2H), 7.88-7.83 (m, 2H), 7.59 (br. s, 1H), 7.23-7.16 (m, 3H), 7.12-7.06 (m, 4H), 3.42 (s, 2H), 1.56 (d, *J* = 15.0 Hz, 1H), 1.47 (d, *J* = 15.0 Hz, 1H), 1.36 (s, 3H), 1.13 (s, 3H), 0.93 (s, 9H);

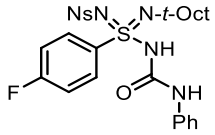
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 179.3, 165.9 (d, *J* = 258.7 Hz), 149.7, 148.8, 136.6 (d, *J* = 3.3 Hz), 134.8, 130.6 (d, *J* = 9.6 Hz), 129.5, 128.6, 128.2, 127.1, 123.9, 116.9 (d, *J* = 23.0 Hz), 62.9, 56.6, 47.2, 31.8, 31.6, 29.4, 29.2 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -102.1 (tt, *J* = 7.8, 4.5 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1349, 1304, 1234, 1157, 1086;

HRMS (ESI^+) calcd. for $C_{28}H_{33}FN_4O_5S_2Na^+$ $[M+Na]^+$: 611.1769; found: 611.1768.

***N*-((4-Fluorophenyl)(3-phenylureido)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (6b)**



Sulfondiimidamide **5am** (86 mg, 0.18 mmol, 1.00 equiv.) and NaH (11 mg, 60 % dispersion in mineral oil, 0.28 mmol, 1.50 equiv.) were added to an oven-dried 25 mL round-bottom flask at room temperature and the flask was purged with nitrogen gas. Anhydrous THF (1.80 mL) was then added. The reaction was stirred at room temperature for 15 min. Phenyl isocyanate (26 mg, 0.22 mmol, 1.20 equiv.) was then added and the reaction was stirred at room temperature for another 30 min. The reaction was quenched with sat. aq. NaCl solution (50 mL). Ethyl acetate (30 mL) was added and the organic layers was separated. The aqueous layer was further extracted with ethyl acetate (2 × 30 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was then purified by flash column chromatography (petrol/ethyl acetate, 3:1) to afford sulfondiimidamide **6b** as a pale-yellow solid (88 mg, 0.15 mmol, 82%).

mp 146-148 °C;

R$_f$ 0.50 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $(CD_3)_2SO$): δ (ppm) = 9.33 (s, 1H), 8.18-8.06 (m, 5H), 7.87 (d, J = 8.8 Hz, 2H), 7.48 (t, J = 8.8 Hz, 2H), 7.34-7.30 (m, 2H), 7.17 (t, J = 7.9 Hz, 2H), 6.91 (t, J = 7.3 Hz, 1H), 1.53 (d, J = 14.7 Hz, 1H), 1.48 (d, J = 14.7 Hz, 1H), 1.19 (s, 3H), 1.10 (s, 3H), 0.87 (s, 9H);

^{13}C NMR (101 MHz, $(CD_3)_2SO$): δ (ppm) = 164.7 (d, J = 253.2 Hz), 154.1, 148.8, 148.4, 139.7, 137.5 (d, J = 2.3 Hz), 131.2 (d, J = 9.8 Hz), 128.4, 128.1, 123.7, 122.0, 117.9, 116.3 (d, J = 23.0 Hz), 60.7, 54.6, 31.19, 31.15, 28.5, 28.3 (note: for *gem*-dimethyl carbons in *tert*-octyl group, NC***(CH$_3$)$_2$***$CH_2C(CH_3)_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

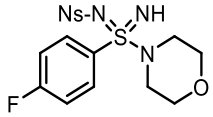
^{19}F NMR (377 MHz, $(CD_3)_2SO$): δ (ppm) = -105.8 (tt, J = 8.7, 4.2 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1349, 1301, 1223, 1156, 1087, 1056, 840, 739;

HRMS (ESI$^+$) calcd. for $C_{27}H_{33}FN_5O_5S_2^+$ $[M+H]^+$: 590.1902; found: 590.1894.

2.2.7 *t*-Octyl Deprotection of Sulfondiimidamide 5a

N-((4-Fluorophenyl)(imino)(morpholino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (6c)



To a solution of sulfondiimidamide **5a** (4.50 g, 8.33 mmol, 1.00 equiv.) in CH_2Cl_2 (83.3 mL) in an oven-dried 250 mL round-bottom flask was added TFA (3.21 mL, 41.70 mmol, 5.00 equiv.) at room temperature. The mixture was stirred at room temperature for 15 min before being concentrated *in vacuo* and diluted with ethyl acetate (200 mL). Then the mixture was basified to pH 10-11 using 1 M aq. NaOH solution (300 mL). The aqueous phase was extracted with ethyl acetate (2 × 100 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 1:1 to 1:2) to afford *sulfondiimidamide* **6c** as a white solid (3.39 g, 7.92 mmol, 95%).

mp 64-66 °C;

R$_f$ 0.50 (petrol/ethyl acetate, 1:2);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.24 (d, J = 9.0 Hz, 2H), 8.08 (d, J = 9.0 Hz, 2H), 7.98-7.93 (m, 2H), 7.23-7.17 (m, 2H), 3.72 (app. t, J = 4.7 Hz, 4H), 3.28 (br. s, 1H), 3.15-3.02 (m, 4H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.9 (d, J = 257.8 Hz), 149.7, 149.3, 130.4 (d, J = 9.5 Hz), 129.3 (d, J = 3.2 Hz), 127.9, 124.1, 116.7 (d, J = 22.9 Hz), 66.2, 46.8;

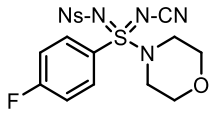
^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -102.9 (tt, J = 8.0, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1528, 1351, 1300, 1154, 1089, 1067, 1052, 920;

HRMS (ESI$^+$) calcd. for $C_{16}H_{18}FN_4O_5S_2^+$ $[M+H]^+$: 429.0697, found: 429.0695.

2.2.8 Functionalisation of Sulfondiimidamide 6c

_N_-((Cyanoimino)(4-fluorophenyl)(morpholino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (6d)



To an oven-dried 250 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **6c** (3.05 g, 7.13 mmol, 1.00 equiv.) in anhydrous CH_3CN (35.7 mL) at room temperature. Et_3N (1.99 mL, 14.3 mmol, 2.00 equiv.) was then added, followed by the addition of BrCN solution (2.14 mL, 5.0 M in CH_3CN, 10.7 mmol, 1.50 equiv.). After being stirred at room temperature for 30 min, the reaction mixture was quenched with sat. aq. $NaHCO_3$ solution (500 mL). The product was extracted with ethyl acetate (3 × 100 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 8:1 to 4:1) to afford *sulfondiimidamide* **6d** as a white solid (3.16 g, 6.98 mmol, 98%).

mp 50-53 °C;

R_f 0.58 (CH_2Cl_2/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.38 (d, J = 8.9 Hz, 2H), 8.22 (d, J = 8.9 Hz, 2H), 8.05-8.00 (m, 2H), 7.39-7.33 (m, 2H), 3.82 (app. t, J = 4.7 Hz, 4H), 3.40 (dt, J = 11.7, 4.6 Hz, 2H), 3.25 (dt, J = 11.7, 4.6 Hz, 2H);

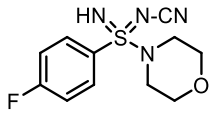
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 167.1 (d, J = 262.0 Hz), 150.5, 147.3, 131.6 (d, J = 10.1 Hz), 128.7, 127.5 (d, J = 3.3 Hz), 124.6, 118.1 (d, J = 23.1 Hz), 109.3, 65.9, 46.7;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -98.3 (tt, J = 7.8, 4.8 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2360, 2208, 1530, 1350, 1166, 1107, 1084, 930, 846;

HRMS (ESI^+) calcd. for $C_{17}H_{16}FN_5O_5S_2Na^+$ $[M+Na]^+$: 476.0469, found: 476.0469.

***N*-((4-Fluorophenyl)(imino)(morpholino)-λ^6-sulfaneylidene)cyanamide (6e)**



To an oven-dried 50 mL round-bottom flask was dissolved sulfondiimidamide **6d** (650 mg, 1.43 mmol, 1.00 equiv.) in anhydrous CH_3CN (14.3 mL) at room temperature. Then 1-dodecanethiol (0.86 mL, 3.58 mmol, 2.50 equiv.) was added, followed by the addition of DBU (0.54 mL, 3.58 mmol, 2.50 equiv.). After being stirred at room temperature for 15 min (judged by TLC), the reaction was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 4:1 to 1:1 to 0:1) without an aqueous workup to afford *sulfondiimidamide* **6e** as a colourless oil (278 mg, 1.04 mmol, 73%).

R$_f$ 0.38 (ethyl acetate);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.03-7.98 (m, 2H), 7.30-7.25 (m, 2H), 3.78-3.72 (m, 4H), 3.12-3.03 (m, 5H);

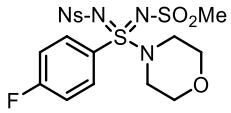
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.1 (d, J = 258.1 Hz), 130.9 (d, J = 9.5 Hz), 128.6 (d, J = 3.1 Hz), 117.1 (d, J = 22.9 Hz), 113.0, 66.2, 46.8;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -102.5 (tt, J = 8.0, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2186, 1588, 1490, 1226, 1109, 924, 839;

HRMS (ESI^+) calcd. for $C_{11}H_{14}FN_4OS^+$ $[M+H]^+$: 269.0867, found: 269.0869.

***N*-((4-Fluorophenyl)((methylsulfonyl)imino)(morpholino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (6f)**



To an oven-dried 25 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **6c** (190 mg, 0.44 mmol, 1.00 equiv.) in anhydrous CH_2Cl_2 (2.2 mL) at room temperature. Et_3N (92 μL, 0.66 mmol, 1.50 equiv.) was then added, followed by the addition of MsCl (61 mg, 0.53 mmol, 1.20 equiv.) and DMAP (11 mg, 0.09 mmol, 0.20 equiv.). After being stirred at room temperature for 30 min, the reaction mixture was quenched with sat. aq. NaCl solution (100 mL).

The product was extracted with CH_2Cl_2 (3 × 50 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 5:1) to afford *sulfondiimidamide* **6f** as a white solid (181 mg, 0.36 mmol, 81%).

mp 56-58 °C;

R_f 0.47 (CH_2Cl_2/ethyl acetate, 5:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.23 (d, J = 8.9 Hz, 2H), 8.05 (d, J = 8.9 Hz, 2H), 7.96-7.91 (m, 2H), 7.24-7.17 (m, 2H), 3.73-3.68 (m, 4H), 3.25 (dt, J = 12.1, 4.8 Hz, 2H), 3.19 (dt, J = 11.0, 4.3 Hz, 2H), 3.15 (s, 3H);

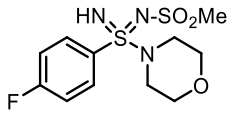
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.5 (d, J = 260.3 Hz), 150.0, 147.6, 131.5 (d, J = 9.9 Hz), 129.5 (d, J = 3.1 Hz), 128.2, 124.1, 117.4 (d, J = 23.1 Hz), 65.9, 46.4, 44.0;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -100.2 (tt, J = 8.2, 4.7 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1530, 1351, 1307, 1169, 1084, 926, 741;

HRMS (ESI^+) calcd. for $C_{17}H_{20}FN_4O_7S_3^+$ $[M+H]^+$: 507.0473, found: 507.0470.

_N_-((4-Fluorophenyl)(imino)(morpholino)-λ^6-sulfaneylidene)methanesulfonamide (6g)



To an oven-dried 25 mL round-bottom flask was dissolved sulfondiimidamide **6f** (152 mg, 0.30 mmol, 1.00 equiv.) in anhydrous CH_3CN (3.0 mL) at room temperature. Then 1-dodecanethiol (0.36 mL, 1.50 mmol, 5.0 equiv.) was added, followed by the addition of DBU (0.21 mL, 1.43 mmol, 4.75 equiv.). After being stirred at room temperature for 15 min (judged by TLC), the reaction mixture was quenched with sat. aq. NaCl solution (100 mL). The product was extracted with ethyl acetate (3 × 50 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (ethyl acetate/MeOH, 1:0 to 9:1) to afford *sulfondiimidamide* **6g** as a colourless oil (68 mg, 0.21 mmol, 71%).

R_f 0.50 (ethyl acetate/MeOH, 9:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.92-7.86 (m, 2H), 7.12-7.06 (m, 2H), 3.61-3.53 (m, 4H), 3.15 (s, 1H), 3.01-2.94 (m, 2H), 2.94-2.85 (m, 5H);

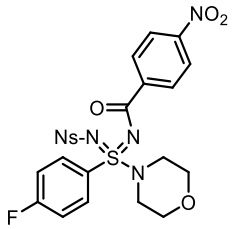
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.7 (d, J = 257.0 Hz), 130.3 (d, J = 9.4 Hz), 129.9 (d, J = 3.1 Hz), 116.6 (d, J = 22.7 Hz), 66.3, 46.9, 44.6;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -103.7 (tt, J = 8.0, 5.1 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1590, 1490, 1292, 1137, 1092, 1051, 1009, 913, 725;

HRMS (ESI^+) calcd. for $C_{11}H_{17}FN_3O_3S_2^+$ $[M+H]^+$: 322.0690, found: 322.0685.

***N*-((4-Fluorophenyl)(morpholino)(((4-nitrophenyl)sulfonyl)imino)-λ^6-sulfaneylidene)-4-nitrobenzamide (6h)**



To an oven-dried 25 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **6c** (164 mg, 0.38 mmol, 1.00 equiv.) in anhydrous CH_2Cl_2 (1.9 mL) at room temperature. Et_3N (80 μL, 0.57 mmol, 1.50 equiv.) was then added, followed by the addition of 4-nitrobenzoyl chloride (78 mg, 0.42 mmol, 1.10 equiv.). After being stirred at room temperature for 1 h, the reaction mixture was quenched with sat. aq. NaCl solution (100 mL). The product was extracted with CH_2Cl_2 (3 × 50 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 7:1 to 4:1) to afford *sulfondiimidamide* **6h** as a white solid (207 mg, 0.36 mmol, 94%).

mp 222-224 °C;

R_f 0.75 (CH_2Cl_2/ethyl acetate, 5:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.18 (d, J = 9.0 Hz, 2H), 8.14-8.09 (m, 2H), 8.04-7.97 (m, 4H), 7.94 (d, J = 9.0 Hz, 2H), 7.34-7.28 (m, 2H), 3.87-3.81 (m, 4H), 3.63-3.56 (m, 2H), 3.45-3.39 (m, 2H);

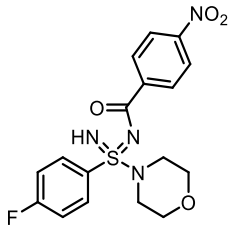
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) =169.1, 166.5 (d, J = 260.0 Hz), 150.5, 149.8, 147.4, 139.6, 131.6 (d, J = 9.9 Hz), 130.2, 129.8 (d, J = 3.2 Hz), 128.6, 123.9, 123.5, 117.6 (d, J = 23.0 Hz), 66.2, 46.2;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -100.4 (tt, J = 7.7, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1525, 1349, 1272, 1107, 1083, 1066, 936, 839, 720;

HRMS (ESI^+) calcd. for $C_{23}H_{21}FN_5O_8S_2^+$ $[M+H]^+$: 578.0810, found: 578.0809.

***N*-((4-Fluorophenyl)(imino)(morpholino)-λ^6-sulfaneylidene)-4-nitrobenzamide (6i)**



To an oven-dried 25 mL round-bottom flask was dissolved sulfondiimidamide **6h** (202 mg, 0.35 mmol, 1.00 equiv.) in anhydrous CH_3CN (3.5 mL) at room temperature. Then 1-dodecanethiol (0.42 mL, 1.75 mmol, 5.00 equiv.) was added, followed by the addition of DBU (0.25 mL, 1.66 mmol, 4.75 equiv.). After being stirred at room temperature for 30 min (judged by TLC), the reaction mixture was quenched with sat. aq. NaCl solution (120 mL). The product was extracted with ethyl acetate (3 × 50 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 1:1 to 1:2) to afford *sulfondiimidamide* **6i** as colourless oil (94 mg, 0.24 mmol, 69%).

R_f 0.39 (CH_2Cl_2/ethyl acetate, 1:2);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.25-8.16 (m, 4H), 8.13-8.08 (m, 2H), 7.27-7.21 (m, 2H), 3.72-3.66 (m, 4H), 3.50 (s, 1H), 3.13 (dt, J = 12.0, 4.8 Hz, 2H), 3.04 (dt, J = 12.0, 4.8 Hz, 2H);

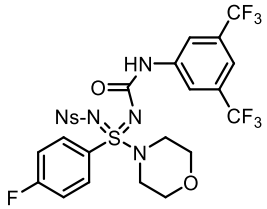
^{13}C NMR (101 MHz, $(CD_3)_2CO$): δ (ppm) = 171.4, 166.2 (d, J = 252.8 Hz), 150.8, 143.3, 132.2(d, J = 1.7 Hz), 131.5 (d, J = 9.5 Hz), 130.9, 124.0, 117.1 (d, J = 23.0 Hz), 66.9, 47.2;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -104.0 (tt, J = 8.0, 4.0 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1627, 1590, 1522, 1490, 1287, 1258, 1138, 1110, 918, 721;

HRMS (ESI^+) calcd. for $C_{17}H_{18}FN_4O_4S^+$ $[M+H]^+$: 393.1027, found: 393.1024.

***N*-((((3,5-Bis(trifluoromethyl)phenyl)carbamoyl)imino)(4-fluorophenyl)(morpholino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (6j)**



To an oven-dried 25 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **6c** (255 mg, 0.60 mmol, 1.00 equiv.) in anhydrous CH_3CN (6.0 mL) at room temperature. DBU (0.13 mL, 0.90 mmol, 1.50 equiv.) was then added, followed by the addition of 3,5-bis(trifluoromethyl)phenyl isocyanate (230 mg, 0.90 mmol, 1.50 equiv.). After being stirred at room temperature for 30 min, the reaction mixture was quenched with sat. aq. NaCl solution (120 mL). The product was extracted with ethyl acetate (3 × 50 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 1:1 to 2:3) to afford *sulfondiimidamide* **6j** as a white solid (322 mg, 0.47 mmol, 79%).

mp 196-198 °C;

R_f 0.39 (petrol/ethyl acetate, 1:1);

^{1}H NMR (400 MHz, $(CD_3)_2SO$): δ (ppm) = 10.01 (s, 1H), 8.18-8.13 (m, 2H), 8.08 (app. br. s, 4H), 7.85 (app. br. s, 2H), 7.59-7.51 (m, 3H), 3.69 (app. t, J = 4.5 Hz, 4H), 3.34-3.22 (m, 4H);

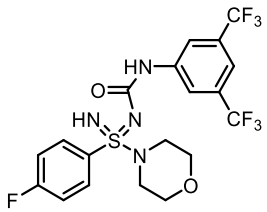
^{13}C NMR (101 MHz, $(CD_3)_2SO$): δ (ppm) = 165.5 (d, J = 254.9 Hz), 154.2, 148.9, 147.5, 141.2, 131.9 (d, J = 10.1 Hz), 130.7 (q, J = 32.7 Hz), 130.1 (d, J = 2.8 Hz), 128.7, 123.8, 123.2 (q, J = 272.6 Hz), 117.2, 117.1 (d, J = 23.2 Hz), 114.7, 65.3, 45.6;

^{19}F NMR (377 MHz, $(CD_3)_2SO$): δ (ppm) = -62.0 (s), -103.6 (tt, J = 9.0, 5.1 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) =1665, 1533, 1277, 1224, 1161, 1132, 1085, 940;

HRMS (ESI$^+$) calcd. for $C_{25}H_{20}F_7N_5O_6S_2Na^+$ $[M+Na]^+$: 706.0635, found: 706.0629.

1-(3,5-Bis(trifluoromethyl)phenyl)-3-((4-fluorophenyl)(imino)(morpholino)-λ^6-sulfaneylidene)urea (6k)



To an oven-dried 25 mL round-bottom flask was dissolved sulfondiimidamide **6j** (180 mg, 0.26 mmol, 1.00 equiv.) in anhydrous CH_3CN (2.6 mL) at 0 °C. Then 1-dodecanethiol (0.32 mL, 1.32 mmol, 5.00 equiv.) was added, followed by the addition of DBU (0.19 mL, 1.25 mmol, 4.75 equiv.). After being stirred at 0 °C for 20 min (judged by TLC), the reaction mixture was quenched with sat. aq. NaCl solution (120 mL). The product was extracted with ethyl acetate (3 × 50 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 1:1 to 1:2) to afford *sulfondiimidamide* **6k** as a coluorless oil (95 mg, 0.19 mmol, 72%).

R$_f$ 0.50 (petrol/ethyl acetate, 1:2);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.07-8.02 (m, 2H), 7.93 (s, 2H), 7.85-7.41 (br. s, 1H), 7.46 (s, 1H), 7.24-7.18 (m, 2H), 3.71 (app. t, J = 4.7 Hz, 4H), 3.43 (s, 1H), 3.10 (dt, J = 11.7, 4.7 Hz, 2H), 3.03 (dt, J = 11.7, 4.7 Hz, 2H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.7 (d, J = 256.6 Hz), 158.2, 141.1, 132.2 (q, J = 33.1 Hz), 130.2 (d, J = 9.3 Hz), 130.0 (d, J = 2.8 Hz), 123.4 (q, J = 272.6 Hz), 118.5, 116.6 (d, J = 22.6 Hz), 115.8, 66.4, 46.6;

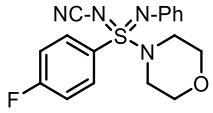
^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -63.0 (s), -104.3 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1638, 1541, 1492, 1474, 1434, 1387, 1277, 1236, 1176, 1129, 924;

HRMS (ESI$^+$) calcd. for $C_{19}H_{18}F_7N_4O_2S^+$ $[M+H]^+$: 499.1033, found: 499.1029.

2.2.9 Functionalisation of Sulfondiimidamide 6e

N-((4-Fluorophenyl)(morpholino)(phenylimino)-λ^6-sulfaneylidene)cyanamide (6l)



Sulfondiimidamide **6e** (83 mg, 0.31 mmol, 1.00 equiv.), phenylboronic acid (94 mg, 0.77 mmol, 2.50 equiv.), $Cu(CH_3CN)_4PF_6$ (58 mg, 0.16 mmol, 0.50 equiv.), *N*-methylpiperidine (277 mg, 2.79 mmol, 9.00 equiv.) were dissolved in anhydrous CH_3CN (3.1 mL) in an oven-dried 25 mL round-bottom flask and under oxygen atmosphere. The reaction was stirred at room temperature for 3 h until completion (judged by TLC). Then the reaction mixture was quenched with sat. aq. NaCl solution (80 mL). The product was extracted with ethyl acetate (3 × 30 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 8:1 to 4:1) to afford *sulfondiimidamide* **6l** as a white solid (81 mg, 0.24 mmol, 76%).

mp 107-109°C;

R$_f$ 0.58 (CH_2Cl_2/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.07-8.02 (m, 2H), 7.32-7.22 (m, 6H), 7.07 (tt, *J* = 7.2, 1.5 Hz, 1H), 3.74-3.62 (m, 4H), 3.20-3.10 (m, 4H);

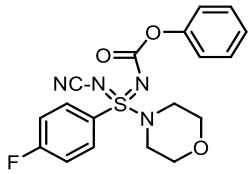
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.0 (d, *J* = 258.1 Hz), 140.6, 131.2 (d, *J* = 9.6 Hz), 129.5, 128.7 (d, *J* = 3.3 Hz), 124.1, 123.9, 117.2 (d, *J* = 22.9 Hz), 112.8, 66.0, 46.8;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -102.3 (tt, *J* = 8.0, 5.0 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 2190, 1588, 1487, 1259, 1238, 1110, 927, 843, 759;

HRMS (ESI^+) calcd. for $C_{17}H_{18}FN_4OS^+$ $[M+H]^+$: 345.1180, found: 345.1181.

Phenyl ((cyanoimino)(4-fluorophenyl)(morpholino)-λ^6-sulfaneylidene)carbamate (6m)



To an oven-dried 25 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **6e** (132 mg, 0.49 mmol, 1.00 equiv.) in anhydrous CH_2Cl_2 (2.5 mL) at room temperature. Et_3N (0.14 mL, 0.98 mmol, 2.0 equiv.) was then added, followed by the addition of phenyl chloroformate (115 mg, 0.73 mmol, 1.50 equiv.) and DMAP (12 mg, 0.098 mmol, 0.20 equiv.). After being stirred at room temperature for 10 min, the reaction mixture was quenched with sat. aq. NaCl solution (100 mL). The product was extracted with CH_2Cl_2 (3 × 40 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 8:1 to 4:1) to afford *sulfondiimidamide* **6m** as a white solid (177 mg, 0.46 mmol, 93%).

mp 132-134 °C;

R$_f$ 0.50 (CH_2Cl_2/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.12-8.07 (m, 2H), 7.38-7.30 (m, 4H), 7.24-7.19 (m, 1H), 7.18-7.14 (m, 2H), 3.80 (app. t, *J* = 4.7 Hz, 4H), 3.39 (dt, *J* = 12.2, 5.0 Hz, 2H), 3.32 (dt, *J* = 12.8, 5.0 Hz, 2H);

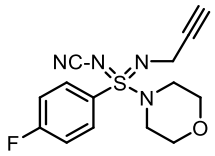
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.5 (d, *J* = 260.3 Hz), 154.5, 151.1, 131.4 (d, *J* = 9.9 Hz), 129.3, 127.6 (d, *J* = 3.0 Hz), 125.8, 121.3, 117.6 (d, *J* = 23.1 Hz), 110.4, 65.8, 46.2;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -99.8 (tt, *J* = 7.9, 4.7 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2202, 1697, 1588, 1489, 1237, 1184, 1158, 1107, 928, 838, 728;

HRMS (ESI^+) calcd. for $C_{18}H_{18}FN_4O_3S^+$ $[M+H]^+$: 389.1078, found: 389.1078.

***N*-((4-Fluorophenyl)(morpholino)(prop-2-yn-1-ylimino)-λ^6-sulfaneylidene)cyanamide (6n)**



To an oven-dried 10 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **6e** (54.9 mg, 0.20 mmol, 1.00 equiv.) in anhydrous CH_3CN (2.1 mL) at room temperature. DBU (92 μL, 0.62 mmol, 3.00 equiv.) was then added and the reaction was stirred at room temperature for 5 min, followed by the addition of propargyl bromide solution (76 mg, 80% wt

in toluene, 0.51 mmol, 2.50 equiv.). The reaction was stirred at room temperature for 16 h until completion (judged by TLC). The reaction was quenched with sat. aq. NaCl solution (100 mL). The product was extracted with ethyl acetate (3 × 30 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2 /ethyl acetate, 10:1 to 4:1) to afford *sulfondiimidamide* **6n** as a white solid (48.3 mg, 0.16 mmol, 77%).

mp 128-131 °C;

R_f 0.54 (CH_2Cl_2/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.99-7.94 (m, 2H), 7.30-7.24 (m, 2H), 4.14 (dd, *J* = 17.4, 2.5 Hz, 1H), 4.02 (dd, *J* = 17.4, 2.5 Hz, 1H), 3.78-3.72 (m, 4H), 3.17 (dt, *J* = 11.9, 4.8 Hz, 2H), 3.07 (dt, *J* = 11.3, 4.2 Hz, 2H), 2.28 (t, *J* = 2.5 Hz, 1H);

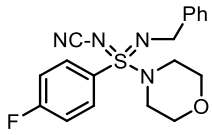
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.0 (d, *J* = 257.9 Hz), 131.0 (d, *J* = 9.6 Hz), 128.4 (d, *J* = 3.2 Hz), 117.1 (d, *J* = 22.8 Hz), 112.9, 81.2, 71.5, 66.1, 47.0, 31.8;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -102.5 (tt, *J* = 8.0, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2190, 1586, 1489, 1260, 1188, 1110, 928;

HRMS (ESI^+) calcd. for $C_{14}H_{16}FN_4OS^+$ $[M+H]^+$: 307.1023, found: 307.1021.

***N*-((Benzylimino)(4-fluorophenyl)(morpholino)-λ^6-sulfaneylidene)cyanamide (6o)**



To an oven-dried 25 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **6e** (120 mg, 0.45 mmol, 1.00 equiv.) in anhydrous CH_3CN (4.5 mL) at room temperature. DBU (0.20 mL, 1.35 mmol, 3.00 equiv.) was then added and the reaction was stirred at room temperature for 5 min, followed by the addition of BnBr (192 mg, 1.12 mmol, 2.50 equiv.). The reaction was stirred at room temperature for 3 h until completion (judged by TLC). The reaction was quenched with sat. aq. NaCl solution (120 mL). The product was extracted with ethyl acetate

(3 × 40 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 9:1 to 4:1) to afford *sulfondiimidamide* **6o** as a colourless oil (131 mg, 0.37 mmol, 81%).

R_f 0.63 (CH_2Cl_2/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.00-7.95 (m, 2H), 7.47-7.42 (m, 2H), 7.38-7.32 (m, 2H), 7.30-7.24 (m, 3H), 4.56 (d, *J* = 14.4 Hz, 1H), 4.38 (d, *J* = 14.4 Hz, 1H), 3.65 (ddd, *J* = 11.8, 6.3, 3.2 Hz, 2H), 3.57 (ddd, *J* = 11.8, 6.3, 3.2 Hz, 2H), 3.03 (ddd, *J* = 11.9, 6.5, 3.2 Hz, 2H), 2.93 (ddd, *J* = 11.9, 6.5, 3.2 Hz, 2H);

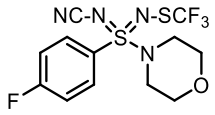
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.8 (d, *J* = 257.5 Hz), 139.4, 130.8 (d, *J* = 9.5 Hz), 128.7 (d, *J* = 3.2 Hz), 128.5, 127.8, 127.2, 116.9 (d, *J* = 22.7 Hz), 113.3, 65.9, 46.8, 46.3;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -102.9 (tt, *J* = 8.0, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2187, 1586, 1489, 1185, 1110, 928, 838;

HRMS (ESI^+) calcd. for $C_{18}H_{20}FN_4OS^+$ $[M+H]^+$: 359.1336, found: 359.1336.

_N_-((4-Fluorophenyl)(morpholino)(((trifluoromethyl)thio)imino)-λ^6-sulfaneylidene)cyanamide (6p)



To an oven-dried 10 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **6e** (170 mg, 0.63 mmol, 1.00 equiv.) in anhydrous CH_3CN (1.26 mL) at room temperature. NBS (112 mg, 0.63 mmol, 1.00 equiv.) was then added. The reaction was stirred at room temperature for 30 min, followed by the addition of a solution of $AgSCF_3$ (158 mg, 0.76 mmol, 1.20 equiv.) in anhydrous CH_3CN (1.9 mL). After being stirred at room temperature for another 30 min, the reaction mixture was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 50:1 to 20:1 to 10:1) to afford *sulfondiimidamide* **6p** as a colourless oil (119 mg, 0.32 mmol, 51%).

R_f 0.57 (CH_2Cl_2/ethyl acetate, 10:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.99-7.94 (m, 2H), 7.35-7.29 (m, 2H), 3.80-3.71 (m, 4H), 3.24-3.12 (m, 4H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 166.5 (d, J = 260.3 Hz), 131.5 (d, J = 9.9 Hz), 130.0 (q, J = 312.0 Hz), 127.2 (d, J = 3.2 Hz), 117.7 (d, J = 23.0 Hz), 110.6, 65.9, 46.9;

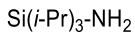
^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -49.8 (s), -100.1 (tt, J = 7.8, 4.7 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) =2200, 1586, 1490, 1159, 1108, 1085, 1007, 930, 841;.

HRMS (ESI^+) calcd. for $C_{12}H_{13}F_4N_4OS_2^+$ $[M+H]^+$: 369.0461, found: 369.0467.

2.2.10 Sulfondiimidamide Synthesis using Tri-isopropylsilyl Sulfinylamine

Triisopropylsilyl amine



Triisopropylsilyl chloride (13.50 g, 70.0 mmol, 1.00 equiv.) was dissolved in anhydrous diethyl ether (140 mL) in an oven-dried 500 mL round-bottom flask. The reaction mixture was cooled to -78 °C. Anhydrous ammonia gas was bubbled through this solution for 2 h, resulting in the formation of a white precipitate. The reaction was then warmed to 0 °C and stirred for another 3 h to remove excess ammonia. Filtration over anhydrous Na_2SO_4 (washed with diethyl ether) and removal of solvent under reduced pressure afforded triisopropylsilyl amine as a colourless oil (12.0 g, 69.4 mmol, 99%).

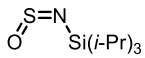
^{1}H NMR (400 MHz, C_6D_6): δ (ppm) = 1.05-1.00 (m, 18H), 0.95-0.85 (m, 3H), -0.12 (s, 2H);

^{13}C NMR (101MHz, C_6D_6): δ (ppm) = 18.4, 12.5;

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2864, 1546, 1463, 1382, 1245, 1011, 882, 817, 658;

HRMS (ESI^+) calcd. for $C_9H_{24}NSi^+$ $[M+H]^+$: 174.1673; mass not found.

Triisopropylsilyl Sulfinylamine (7)



Triisopropylsilyl amine (5.20 g, 30.0 mmol, 1.00 equiv.) was dissolved in anhydrous diethyl ether (600 mL) in an oven-dried 1 L round-bottom flask. The reaction was cooled to 0 °C and anhydrous Et_3N (8.41 mL, 61.8 mmol, 2.06 equiv.) was added. Freshly distilled thionyl chloride (2.25 mL, 30.9 mmol, 1.03 equiv.) was then added dropwise. The reaction was stirred at 0 °C for 1.5 h. Filtration over Na_2SO_4 (washed with diethyl ether) and removal of solvent under reduced pressure afforded tri-*iso*propylsilyl sulfinylamine **7** as a pale-yellow oil (6.56 g, 30.0 mmol, 100%).

Notes

1. Tri-*iso*propylsilyl sulfinylamine should be stored in the freezer (-20 °C) and can be used without loss of performance for at least 1 month.
2. **CAUTION: Hydrolysis of sulfinylamines results in the formation of toxic sulfur dioxide gas.** Evolution of SO_2 from TIPS-NSO has not been observed in the normal course of use, but

avoidance of contact with water or prolonged storage at room temperature is advised.

3. During the workup stage diethyl ether was removed in a rotary evaporator with the bath temperature set to 30 °C or lower.

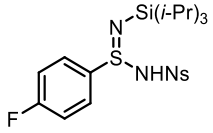
^{1}H NMR (400 MHz, C_6D_6): δ (ppm) = 1.19-0.96 (m, 21H);

^{13}C NMR (101MHz, C_6D_6): δ (ppm) = 18.0, 12.4;

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2980, 1463, 1385, 1308, 1128, 882, 682, 664;

HRMS (ESI^+) calcd. for $C_9H_{22}NOSSi^+$ $[M+H]^+$: 220.1186; mass not found.

***N*-(*S*-(4-Fluorophenyl)-*N*-(triisopropylsilyl)sulfinimidoyl)-4-nitrobenzenesulfonamide (10)**



Triisopropylsilyl sulfinylamine 7 (1.73 g, 7.90 mmol, 1.00 equiv.) was dissolved in anhydrous THF (15.8 mL) in an oven-dried 250 mL round-bottom flask and was purged with nitrogen gas. The mixture was cooled to -30 °C before LiHMDS solution (7.90 mL, 1.00 M in THF, 7.90 mmol, 1.00 equiv.) was added. After being stirred at - 30 °C for 5 min, the reaction was warmed to 0 °C and stirred for another 5 min. TMSCl (1.00 mL, 7.90 mmol, 1.00 equiv.) was added and the reaction was stirred at 0 °C for 10 min. 4-Fluorophenylmagnesium bromide solution (10.53 mL, 0.90 M in THF, 9.48 mmol, 1.20 equiv.) was then added and the reaction was stirred at 0 °C for 10 min. The reaction mixture was then quenched with sat. aq. tetrasodium EDTA solution (250 mL). Ethyl acetate (150 mL) was added and the organic layer was separated. The aqueous layer was further extracted with ethyl acetate (2 × 80 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude mixture was dissolved in anhydrous CH_2Cl_2 (39.5 mL) in an oven-dried 250 mL round-bottom flask at 0 °C before Et_3N (1.32 mL, 9.48 mmol, 1.20 equiv.) and NsCl (1.75 g, 7.90 mmol, 1.00 equiv.) were added. The reaction was stirred at 0 °C for 20 min and then was quenched with sat. aq. NaCl solution (150 mL) and extracted with CH_2Cl_2 (3 × 80 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered, concentrated under reduced pressure and purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 100:1 to 30:1 to 20:1) to afford *sulfinamidine* **10** as a white solid (3.52 g, 7.05 mmol, 89%).

mp 148-150 °C;

R_f 0.64 (CH_2Cl_2/ethyl acetate, 25:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.18 (d, *J* = 8.9 Hz, 2H), 7.87 (d, *J* = 8.9 Hz, 2H), 7.63-7.58 (m, 2H), 7.13-7.07 (m, 2H), 4.53 (s, 1H), 1.32-1.20 (m, 3H), 1.13-1.06 (m, 18H);

^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 164.7 (d, *J* = 254.8 Hz), 150.3, 149.2, 136.6 (d, *J* = 3.2 Hz), 128.8 (d, *J* = 9.1 Hz), 127.4, 123.8, 116.8 (d, *J* = 22.7 Hz), 17.94, 17.90, 12.0 (note: for dimethyl carbons in tri-*iso*propylsilyl group, NSi (CH$(CH_3)_2$)$_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -106.7 (tt, *J* = 8.1, 4.9 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1527, 1490, 1389, 1347, 1299, 1227, 1149, 1088, 954,786, 608;

HRMS (ESI^+) calcd. for $C_{21}H_{31}FN_3O_4S_2Si^+$ $[M+H]^+$: 500.1504, found: 500.1504;

4-Fluoro-*N*-((4-nitrophenyl)sulfonyl)-*N*-(triisopropylsilyl)benzenesulfondiimidoyl fluoride (11)

An oven-dried 50 mL round-bottom flask was charged with sulfinamidine **10** (998 mg, 2.00 mmol, 1.00 equiv.) and NaH (88 mg, 60 % dispersion in mineral oil, 2.20 mmol, 1.10 equiv.) at 0 °C and was purged with nitrogen gas. Anhydrous THF (4.00 mL) was added. The reaction was stirred at 0 °C for 5 min before being warmed to room temperature and stirred for another 25 min. NFSI (945 mg, 3.00 mmol, 1.50 equiv.) was then added under a positive pressure of nitrogen and the reaction was stirred at room temperature for 30 min before being quenched with sat. aq. NaCl solution (150 mL). Ethyl acetate (100 mL) was added and the organic layer was separated. The aqueous layer was further extracted with ethyl acetate (2 × 40 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure to give a crude solid. Diethyl ether (150 ml) was added to the crude solid and the resulting suspension was shaken well before being filtered. The white filter cake was washed with diethyl ether (80 ml) and CH_2Cl_2 (80 ml). The combined filtrate was concentrated under reduced pressure to give a crude product. The crude product was then purified by flash column chromatography (petrol/ethyl acetate, 6:1) to afford *sulfondiimidoyl fluoride* **11** as a

colourless oil (941 mg, 1.82 mmol, 91%).

R_f 0.42 (petrol/ethyl acetate, 6:1);

^{1}H NMR (400 MHz, CD_3CN): δ (ppm) = 8.27 (d, J = 9.0 Hz, 2H), 8.00-7.94 (m, 4H), 7.34-7.28 (m, 2H), 1.23-1.13 (m, 3H), 1.05 (d, J = 2.9 Hz, 9H), 1.03 (d, J = 2.9 Hz, 9H);

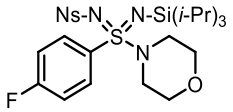
^{13}C NMR (101 MHz, CD_3CN): δ (ppm) = 167.0 (d, J = 256.4 Hz), 151.1, 148.8, 136.2 (dd, J = 28.5, 3.1 Hz), 131.3 (d, J = 10.2 Hz), 128.8, 125.3, 118.0 (d, J = 23.5 Hz), 18.3, 18.2, 13.4 (d, J = 1.9 Hz) (note: for dimethyl carbons in tri-*iso*propylsilyl group, NSi (CH**(*CH*$_3$)$_2$**)$_3$, 2 peaks were found instead of 1 due to the loss of symmetry caused by chiral sulfur atom);

^{19}F NMR (377 MHz, CD_3CN): δ (ppm) = 87.6 (s), -103.3 (tt, J = 8.7, 4.8 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1531, 1403, 1348, 1251, 1163, 1113, 1090, 855, 683, 614;

HRMS (ESI^+) calcd. for $C_{21}H_{29}F_2N_3O_4S_2SiNa^+$ $[M+Na]^+$: 540.1229, found: 540.1228.

N-((4-Fluorophenyl)(morpholino)((triisopropylsilyl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (12)



Sulfondiimidoyl fluoride **11** (305 mg, 0.59 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (389 mg, 0.65 mmol, 1.10 equiv.) were added to an oven-dried 10 mL round-bottom flask and dissolved in anhydrous *t*-AmylOH (1.18 mL). Then morpholine (113 mg, 1.30 mmol, 2.20 equiv.) was added and the reaction was stirred at 60 °C for 45 h until completion (judged by TLC). The mixture was then diluted with ethyl acetate (100 mL) and quenched with sat. aq. NaCl solution (250 mL). The organic layer was separated and the aqueous layer was extracted with ethyl acetate (2 × 100 mL). The combined organic layers were dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 3:1 to 2:1) to afford *sulfondiimidamide* **12** as a colourless oil (252 mg, 0.43 mmol, 73%).

R_f 0.41 (petrol/ethyl acetate, 3:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.26 (d, J = 8.9 Hz, 2H), 8.04 (d, J = 8.9 Hz, 2H), 7.87-7.82 (m, 2H), 7.18-7.12 (m, 2H), 3.71-3.66 (m, 4H), 3.15 (dt, J = 11.8, 4.6 Hz, 2H), 3.03 (dt, J = 11.8, 4.6 Hz, 2H), 1.07-0.96 (m, 21H);

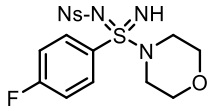
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 165.2 (d, J = 256.3 Hz), 149.8, 149.4, 135.8 (d, J = 3.2 Hz), 130.2 (d, J = 9.2 Hz), 127.6, 123.8, 116.3 (d, J = 22.6 Hz), 66.3, 46.5, 18.3, 13.2;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -104.7 (tt, J = 8.0, 5.0 Hz);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1374, 1297, 1153, 1086, 1064, 1011, 922, 738, 680;

HRMS (ESI^+) calcd. for $C_{25}H_{37}FN_4O_5S_2SiNa^+$ $[M+Na]^+$: 607.1851, found: 607.1849.

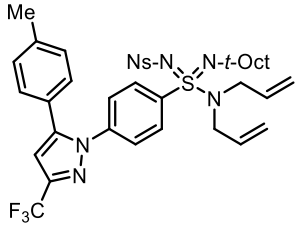
***N*-((4-Fluorophenyl)(imino)(morpholino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (6c)**



To a solution of sulfondiimidamide **12** (222 mg, 0.38 mmol, 1.00 equiv.) in anhydrous THF (3.80 mL) in an oven-dried 25 mL round-bottom flask was added TBAF solution (0.42 mL, 1.00 M in THF, 0.42 mmol, 1.10 equiv.) at 0 °C. After being stirred at 0 °C for 10 min, the reaction mixture was quenched with sat. aq. NaCl solution (120 mL). The product was extracted with ethyl acetate (3 × 60 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 3:1 to 2:1) to afford *sulfondiimidamide* **6c** as a white solid (158 mg, 0.37 mmol, 97%).

2.2.11 Synthesis of Sulfondiimidamide Analogue of Celecoxib

_N_-((Diallylamino)(4-(5-(_p_-tolyl)-3-(trifluoromethyl)-1_H_-pyrazol-1-yl)phenyl)((2,4,4-trimethylpentan-2-yl)imino)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (13 (i))



Sulfondiimidoyl fluoride **4p** (370 mg, 0.54 mmol, 1.00 equiv.), $Ca(NTf_2)_2$ (356 mg, 0.59 mmol, 1.10 equiv.) were added to an oven-dried 10 mL round-bottom flask and dissolved in anhydrous *t*-AmylOH (1.10 mL). Then diallyl amine (262 mg, 2.70 mmol, 5.00 equiv.) was added and the reaction was stirred at 70 °C for 18 h. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 4:1) without an aqueous workup to afford *sulfondiimidamide* **13 (i)** as a white solid (306 mg, 0.40 mmol, 75%).

mp 140-142 °C;

R$_f$ 0.50 (petrol/ethyl acetate, 4:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.09 (d, *J* = 8.8 Hz, 2H), 7.74 (d, *J* = 8.8 Hz, 2H), 7.66 (d, *J* = 8.8 Hz, 2H), 7.33 (d, *J* = 8.8 Hz, 2H), 7.19 (d, *J* = 8.5 Hz, 2H), 7.12 (d, *J* = 8.5 Hz, 2H), 6.73 (s, 1H), 5.51 (dddd, *J* = 16.3, 10.2, 7.5, 5.9 Hz, 2H), 5.14-5.04 (m, 4H), 3.94 (dd, *J* = 15.1, 5.9 Hz, 2H), 3.74 (dd, *J* = 15.1, 7.6 Hz, 2H), 2.38 (s, 3H), 1.72 (d, *J* = 14.5 Hz, 1H), 1.61 (d, *J* = 14.5 Hz, 1H), 1.59 (s, 3H), 1.50 (s, 3H), 1.06 (s, 9H);

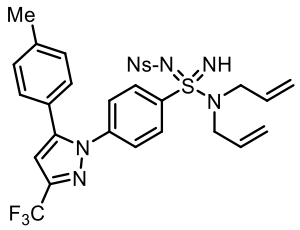
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 149.6, 149.2, 145.2, 144.2 (q, *J* = 38.5 Hz), 142.2, 141.3, 139.9, 132.5, 129.8, 128.9, 128.8, 127.3, 125.9, 125.2, 123.7, 121.1 (q, *J* = 269.4 Hz), 120.0, 106.4, 60.3, 57.5, 50.1, 31.88, 31.85, 31.5, 31.4, 21.4;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -62.4 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1530, 1473, 1382, 1237, 1155, 1089, 1012, 954;

HRMS (ESI^+) calcd. for $C_{37}H_{44}F_3N_6O_4S_2^+$ $[M+H]^+$: 757.2812, found: 757.2802.

***N*-((Diallylamino)(imino)(4-(5-(*p*-tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)phenyl)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (13 (ii))**



To a solution of sulfondiimidamide **13 (i)** (275 mg, 0.36 mmol, 1.00 equiv.) in CH_2Cl_2 (3.60 mL) in an oven-dried 25 mL round-bottom flask was added TFA (0.14 mL, 1.82 mmol, 5.00 equiv.) at room temperature. The mixture was stirred at room temperature for 15 min before being concentrated *in vacuo* and diluted with ethyl acetate (50 mL). Then the mixture was basified to pH 10-11 using 1 M aq. NaOH solution (60 mL). The aqueous phase was extracted with ethyl acetate (2 × 30 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 4:1 to 2:1) to afford *sulfondiimidamide* **13 (ii)** as a colourless oil (212 mg, 0.33 mmol, 91%).

R$_f$ 0.54 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, CD_3CN): δ (ppm) = 8.21 (d, J = 8.8 Hz, 2H), 8.00 (d, J = 8.8 Hz, 2H), 7.93 (d, J = 8.9 Hz, 2H), 7.41 (d, J = 8.9 Hz, 2H), 7.17 (d, J = 8.2 Hz, 2H), 7.12 (d, J = 8.2 Hz, 2H), 6.89 (s, 1H), 5.60 (ddt, J = 16.6, 10.2, 6.3 Hz, 2H), 5.22-5.06 (m, 4H), 3.91 (ddt, J = 15.5, 6.2, 1.6 Hz, 2H), 3.84 (ddt, J = 15.5, 6.4, 1.3 Hz, 2H), 3.70 (s, 1H), 2.32 (s, 3H);

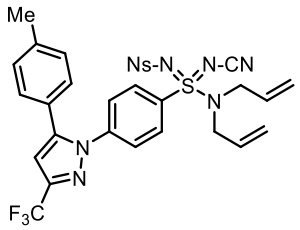
^{13}C NMR (101 MHz, CD_3CN): δ (ppm) = 150.6, 150.4, 146.6, 144.2 (q, J = 38.1 Hz), 143.8, 140.8, 139.9, 133.3, 130.4, 129.9, 129.2, 128.8, 126.8, 126.7, 125.0, 122.5 (q, J = 268.2 Hz), 120.0, 107.1 (q, J = 2.1 Hz), 50.6, 21.4;

^{19}F NMR (377 MHz, CD_3CN): δ (ppm) = -62.7 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 1529, 1473, 1462, 1382, 1239, 1154, 1088, 1011, 954;

HRMS (ESI$^+$) calcd. for $C_{29}H_{28}F_3N_6O_4S_2^+$ $[M+H]^+$: 645.1560, found: 645.1555.

***N*-((Cyanoimino)(diallylamino)(4-(5-(*p*-tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)phenyl)-λ^6-sulfaneylidene)-4-nitrobenzenesulfonamide (13)**



To an oven-dried 50 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **13 (ii)** (800 mg, 1.24 mmol, 1.00 equiv.) in anhydrous CH_3CN (6.2 mL) at room temperature. Et_3N (0.35 mL, 2.50 mmol, 2.00 equiv.) was then added, followed by the addition of BrCN solution (0.37 mL, 5.0 M in CH_3CN, 1.85 mmol, 1.50 equiv.). After being stirred at room temperature for 10 min, the reaction mixture was quenched with sat. aq. $NaHCO_3$ solution (100 mL). The product was extracted with ethyl acetate (3 × 60 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 3:1 to 2:1) to afford *sulfondiimidamide* **13** as a pale-yellow oil (780 mg, 1.17 mmol, 94%).

R$_f$ 0.51 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 8.30 (d, *J* = 8.9 Hz, 2H), 8.16 (d, *J* = 8.9 Hz, 2H), 7.95 (d, *J* = 9.0 Hz, 2H), 7.57 (d, *J* = 9.0 Hz, 2H), 7.18 (d, *J* = 8.0 Hz, 2H), 7.10 (d, *J* = 8.0 Hz, 2H), 6.73 (s, 1H), 5.66 (ddt, *J* = 16.8, 10.2, 6.6 Hz, 2H), 5.30-5.20 (m, 4H), 4.05 (dd, *J* = 15.5, 6.4 Hz, 2H), 3.94 (dd, *J* = 15.5, 6.8 Hz, 2H), 2.36 (s, 3H);

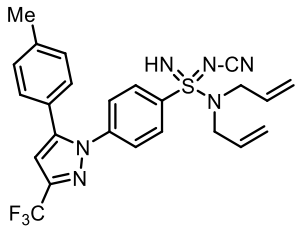
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 150.1, 147.3, 145.6, 144.51, 144.50 (q, *J* = 38.7 Hz), 140.2, 133.9, 130.1, 129.9, 129.2, 128.6, 128.4, 125.6, 125.3, 124.3, 121.8, 120.8 (q, *J* = 269.4 Hz), 109.4, 107.0, 50.1, 21.2;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -62.5 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2360, 2208, 1531, 1473, 1462, 1382, 1239, 1162, 1081, 954;

HRMS (ESI^+) calcd. for $C_{30}H_{27}F_3N_7O_4S_2^+$ $[M+H]^+$: 670.1513, found: 670.1522.

***N, N*-diallyl-*N*'-cyano-4-(5-(*p*-tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)benzenesulfondiimidamide (14 (i))**



To an oven-dried 50 mL round-bottom flask was dissolved sulfondiimidamide **13** (463 mg, 0.69 mmol, 1.00 equiv.) in anhydrous CH_3CN (6.90 mL) at 0 °C. Then 1-dodecanethiol (0.83 mL, 3.47 mmol, 5.00 equiv.) was added, followed by the addition of DBU (0.50 mL, 3.28 mmol, 4.75 equiv.). After being stirred at 0 °C for 5 min (judged by TLC), the reaction mixture was quenched with sat. aq. NaCl solution (100 mL). The product was extracted with ethyl acetate (3 × 60 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (petrol/ethyl acetate, 2:1 to 1:1) to afford *sulfondiimidamide* **14 (i)** as a pale-yellow oil (301 mg, 0.62 mmol, 90%).

R_f 0.40 (petrol/ethyl acetate, 3:2);

^{1}H NMR (400 MHz, CD_3CN): δ (ppm) = 8.02 (d, J = 8.8 Hz, 2H), 7.51 (d, J = 8.8 Hz, 2H), 7.20 (d, J = 8.2 Hz, 2H), 7.16 (d, J = 8.2 Hz, 2H), 6.92 (s, 1H), 5.65 (ddt, J = 17.2, 10.1, 6.3 Hz, 2H), 5.24-5.14 (m, 4H), 3.98-3.83 (m, 5H), 2.34 (s, 3H);

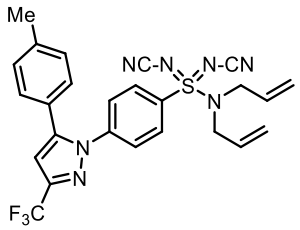
^{13}C NMR (101 MHz, CD_3CN): δ (ppm) = 146.7, 144.2 (q, J = 37.8 Hz), 144.0, 140.8, 139.1, 133.1, 130.4, 129.9, 129.4, 127.0, 126.6, 122.4 (q, J = 268.2 Hz), 120.1, 114.0, 107.1 (q, J = 2.1 Hz), 50.6, 21.3;

^{19}F NMR (377 MHz, CD_3CN): δ (ppm) = -62.8 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2188, 1495, 1471, 1373, 1235, 1160, 1133, 1097, 974, 808;

HRMS (ESI^+) calcd. for $C_{24}H_{24}F_3N_6S^+$ $[M+H]^+$: 485.1730, found: 485.1732.

***N, N*-diallyl-*N*'-cyano-*N*''-cyano-4-(5-(*p*-tolyl)-3-(trifluoromethyl)-1*H*-pyrazol-1-yl)benzenesulfondiimidamide (14)**



To an oven-dried 50 mL round-bottom flask under nitrogen atmosphere was dissolved sulfondiimidamide **14 (i)** (1.26 g, 2.60 mmol, 1.00 equiv.) in anhydrous CH_3CN (13.0 mL) at room temperature. Et_3N (0.73 mL, 5.24 mmol, 2.00 equiv.) was then added, followed by the addition of BrCN solution (0.78 mL, 5.0 M in CH_3CN, 3.90 mmol, 1.50 equiv.). After being stirred at room temperature for 20 min, the reaction mixture was quenched with sat. aq. $NaHCO_3$ solution (200 mL). The product was extracted with ethyl acetate (3 × 80 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (CH_2Cl_2/ethyl acetate, 50:1 to 20:1) to afford *sulfondiimidamide* **14** as a pale-yellow oil (1.21 g, 2.38 mmol, 91%).

R$_f$ 0.57 (petrol/ethyl acetate, 2:1);

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.97 (d, J = 9.0 Hz, 2H), 7.63 (d, J = 9.0 Hz, 2H), 7.22 (d, J = 8.0 Hz, 2H), 7.13 (d, J = 8.0 Hz, 2H), 6.75 (s, 1H), 5.67 (ddt, J = 16.8, 10.1, 6.6 Hz, 2H), 5.37-5.23 (m, 4H), 3.98 (d, J = 6.6 Hz, 4H), 2.39 (s, 3H);

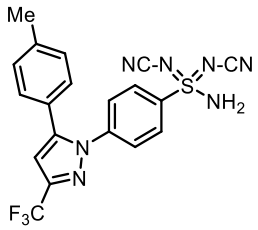
^{13}C NMR (101 MHz, $CDCl_3$): δ (ppm) = 145.8, 145.1, 144.9 (q, J = 38.9 Hz), 140.5, 132.0, 130.1, 129.7, 129.4, 128.8, 125.9, 125.4, 122.5, 120.9 (q, J = 269.4 Hz), 109.0, 107.3 (q, J = 2.2 Hz), 50.1, 21.4;

^{19}F NMR (377 MHz, $CDCl_3$): δ (ppm) = -62.6 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2204, 1592, 1471, 1372, 1236, 1161, 1135, 1096, 973, 888;

HRMS (ESI^+) calcd. for $C_{25}H_{23}F_3N_7S^+$ $[M+H]^+$: 510.1682, found: 510.1677.

_N_'-cyano-_N_''-cyano-4-(5-(_p_-tolyl)-3-(trifluoromethyl)-1_H_-pyrazol-1-yl)benzenesulfondiimidamide (15)



Sulfondiimidamide **14** (426 mg, 0.84 mmol, 1.00 equiv.), 1,3-dimethylbarbituric acid (783 mg, 5.02 mmol, 6.00 equiv.), $Pd(PPh_3)_4$ (194 mg, 0.17 mmol, 0.20 equiv.) were dissolved in anhydrous, degassed CH_2Cl_2 (4.20 mL) in an oven-dried 25 mL round-bottom flask and under nitrogen atmosphere. The reaction was stirred at 35 °C for 2 h. The crude product was purified by flash column chromatography (ethyl acetate/ethanol, 1:0 to 3:1) without an aqueous workup to afford *sulfondiimidamide* **15** as a white solid (336 mg, 0.78 mmol, 93%).

mp 208-210 °C;

R_f 0.50 (ethyl acetate/ethanol, 4:1);

^{1}H NMR (400 MHz, $(CD_3)_2SO$): δ (ppm) = 8.01 (d, J = 8.7 Hz, 2H), 7.52 (d, J = 8.7 Hz, 2H), 7.20 (s, 4H), 7.11 (s, 1H), 4.80-2.90 (m, 2H), 2.30 (s, 3H);

^{13}C NMR (101 MHz, $(CD_3)_2SO$): δ (ppm) = 145.4, 144.8, 142.4 (q, J = 37.7 Hz), 141.1, 139.3, 129.6, 128.8, 127.1, 125.8, 125.4, 121.4 (q, J = 269.0 Hz), 116.5, 106.1, 20.9;

^{19}F NMR (377 MHz, $(CD_3)_2SO$): δ (ppm) = -61.0 (s);

IR (ATR): $\tilde{\nu}$ (cm^{-1}) = 2162, 1472, 1377, 1238, 1162, 1053, 1025, 1006, 821;

HRMS (ESI^+) calcd. for $C_{19}H_{15}F_3N_7S^+$ $[M+H]^+$: 430.1056, found: 430.1055.

3. Calculated Physical Properties

Calculated using the SwissADME platform.[3]

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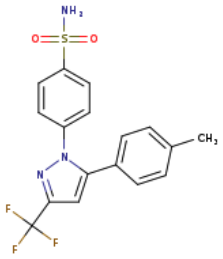

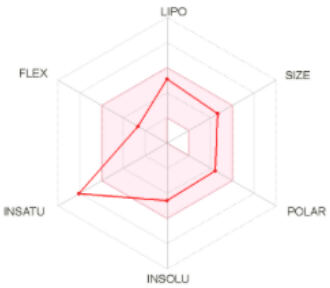

SMILES Cc1ccc(cc1)c1cc(nn1c1ccc(cc1)S(=O)(=O)N)C(F)(F)F

Physicochemical Properties	
Formula	C17H14F3N3O2S
Molecular weight	381.37 g/mol
Num. heavy atoms	26
Num. arom. heavy atoms	17
Fraction Csp3	0.12
Num. rotatable bonds	4
Num. H-bond acceptors	7
Num. H-bond donors	1
Molar Refractivity	89.96
TPSA	86.36 Å²

Lipophilicity	
Log $P_{o/w}$ (iLOGP)	2.56
Log $P_{o/w}$ (XLOGP3)	3.40
Log $P_{o/w}$ (WLOGP)	5.75
Log $P_{o/w}$ (MLOGP)	2.65
Log $P_{o/w}$ (SILICOS-IT)	2.63
Consensus Log $P_{o/w}$	3.40

Water Solubility	
Log *S* (ESOL)	-4.57
Solubility	1.04e-02 mg/ml ; 2.71e-05 mol/l
Class	Moderately soluble
Log *S* (Ali)	-4.89
Solubility	4.88e-03 mg/ml ; 1.28e-05 mol/l
Class	Moderately soluble
Log *S* (SILICOS-IT)	-6.22
Solubility	2.29e-04 mg/ml ; 6.01e-07 mol/l
Class	Poorly soluble

Pharmacokinetics	
GI absorption	High
BBB permeant	No
P-gp substrate	No
CYP1A2 inhibitor	Yes
CYP2C19 inhibitor	No
CYP2C9 inhibitor	Yes
CYP2D6 inhibitor	No
CYP3A4 inhibitor	No
Log K_p (skin permeation)	-6.21 cm/s

Druglikeness	
Lipinski	Yes; 0 violation
Ghose	No; 1 violation: WLOGP>5.6
Veber	Yes
Egan	Yes
Muegge	Yes
Bioavailability Score	0.55

Medicinal Chemistry	
PAINS	0 alert
Brenk	0 alert
Leadlikeness	No; 1 violation: MW>350
Synthetic accessibility	2.74

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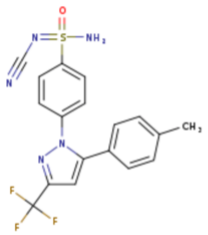

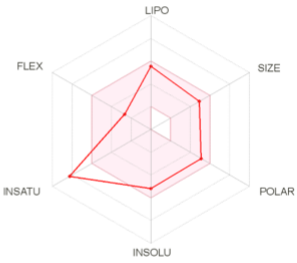

SMILES N#CN=S(=O)(c1ccc(cc1)n1nc(cc1c1ccc(cc1)C)C(F)(F)F)N

Physicochemical Properties	
Formula	C18H14F3N5OS
Molecular weight	405.40 g/mol
Num. heavy atoms	28
Num. arom. heavy atoms	17
Fraction Csp3	0.11
Num. rotatable bonds	4
Num. H-bond acceptors	8
Num. H-bond donors	1
Molar Refractivity	97.32
TPSA	105.44 Å²
Lipophilicity	
Log $P_{o/w}$ (iLOGP)	0.00
Log $P_{o/w}$ (XLOGP3)	4.23
Log $P_{o/w}$ (WLOGP)	6.07
Log $P_{o/w}$ (MLOGP)	3.21
Log $P_{o/w}$ (SILICOS-IT)	3.14
Consensus Log $P_{o/w}$	3.33

Water Solubility	
Log *S* (ESOL)	-5.20
Solubility	2.54e-03 mg/ml ; 6.26e-06 mol/l
Class	Moderately soluble
Log *S* (Ali)	-6.15
Solubility	2.84e-04 mg/ml ; 7.00e-07 mol/l
Class	Poorly soluble
Log *S* (SILICOS-IT)	-6.43
Solubility	1.50e-04 mg/ml ; 3.70e-07 mol/l
Class	Poorly soluble
Pharmacokinetics	
GI absorption	Low
BBB permeant	No
P-gp substrate	Yes
CYP1A2 inhibitor	No
CYP2C19 inhibitor	Yes
CYP2C9 inhibitor	No
CYP2D6 inhibitor	No
CYP3A4 inhibitor	No
Log K_p (skin permeation)	-5.77 cm/s
Druglikeness	
Lipinski	Yes; 0 violation
Ghose	No; 1 violation: WLOGP>5.6
Veber	Yes
Egan	No; 1 violation: WLOGP>5.88
Muegge	Yes
Bioavailability Score	0.55
Medicinal Chemistry	
PAINS	0 alert
Brenk	1 alert: cyanate_aminonitrile_thiocyanate
Leadlikeness	No; 2 violations: MW>350, XLOGP3>3.5
Synthetic accessibility	3.67

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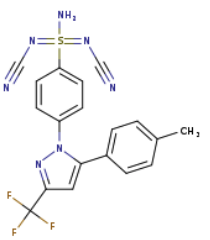

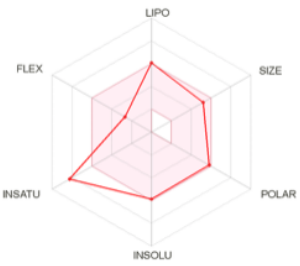

SMILES N#CN=S(=NC#N)(c1ccc(cc1)n1nc(cc1c1ccc(cc1)C)C(F)(F)F)N

Physicochemical Properties	
Formula	C19H14F3N7S
Molecular weight	429.42 g/mol
Num. heavy atoms	30
Num. arom. heavy atoms	17
Fraction Csp3	0.11
Num. rotatable bonds	4
Num. H-bond acceptors	9
Num. H-bond donors	1
Molar Refractivity	104.67
TPSA	124.52 Å²
Lipophilicity	
Log $P_{o/w}$ (iLOGP)	0.00
Log $P_{o/w}$ (XLOGP3)	5.12
Log $P_{o/w}$ (WLOGP)	6.39
Log $P_{o/w}$ (MLOGP)	2.57
Log $P_{o/w}$ (SILICOS-IT)	3.02
Consensus Log $P_{o/w}$	3.42

Water Solubility	
Log *S* (ESOL)	-5.88
Solubility	5.62e-04 mg/ml ; 1.31e-06 mol/l
Class	Moderately soluble
Log *S* (Ali)	-7.48
Solubility	1.42e-05 mg/ml ; 3.32e-08 mol/l
Class	Poorly soluble
Log *S* (SILICOS-IT)	-6.64
Solubility	9.81e-05 mg/ml ; 2.29e-07 mol/l
Class	Poorly soluble
Pharmacokinetics	
GI absorption	Low
BBB permeant	No
P-gp substrate	No
CYP1A2 inhibitor	No
CYP2C19 inhibitor	No
CYP2C9 inhibitor	No
CYP2D6 inhibitor	No
CYP3A4 inhibitor	No
Log K_p (skin permeation)	-5.28 cm/s
Druglikeness	
Lipinski	Yes; 0 violation
Ghose	No; 1 violation: WLOGP>5.6
Veber	Yes
Egan	No; 1 violation: WLOGP>5.88
Muegge	No; 1 violation: XLOGP3>5
Bioavailability Score	0.55
Medicinal Chemistry	
PAINS	0 alert
Brenk	1 alert: cyanate_aminonitrile_thiocyanate
Leadlikeness	No; 2 violations: MW>350, XLOGP3>3.5
Synthetic accessibility	3.35

4. References

1 Zhang, Z. X., Davies, T. Q., and Willis, M. C. (2019). Modular sulfondiimine synthesis using a stable sulfinylamine reagent. J. Am. Chem. Soc. *141*, 13022-13027. 10.1021/jacs.9b06831.

2 Love, B. E., and Jones, E. G. (1999). The use of salicylaldehyde phenylhydrazone as an indicator for the titration of organometallic reagents.. J. Org. Chem. *64(10)*, 3755-3756. 10.1021/jo982433e.

3 Daina, A., Michielin, O., and Zoete, V. (2017). SwissADME: a free web tool to evaluate pharmacokinetics, drug-likeness and medicinal chemistry friendliness of small molecules. Sci. Rep. *7*, 42717. 10.1038/srep42717.