



Materials & Design Virtual Special Issue: Recent advances in materials for sports technology



Over the last few decades, the impact of technological advancements on sports performance has become progressively more and more significant – to the extent that sometimes they are deprecatingly referred to collectively as technology doping. On the other hand, it is clear that there is real and significant scope for research into enhancing the properties and functionality of materials used in competition and training, and creating new designs that not only help sportsmen produce record-beating performance, but also ensure safety and help avoid injury. Ample scientific evidence shows that the usage of engineered materials plays a key role in enhancing the performance of athletes. For instance, wheelchairs for competitors in the Paralympics are now mostly made out of lightweight metallic alloys, and considerable emphasis during their design is placed on aerodynamics. In pole vaulting there has been immense progress in achievement as poles originally crafted from wood have become mostly made from fibre-reinforced composites [1]. As a striking example of the impact on performance one observes that over 90% of the swimming competition winners at the 2008 Olympics in Beijing wore Speedo's LZR Racer suit [2], which included polyurethane structures for body compression. Heat management and reduction in friction are just two aspects of enhanced functionality incorporated into synthetic fabrics for athletes. Other numerous examples of advanced materials and nanotechnology changing the face of the sport can be drawn from disciplines that rely on the combined performance of human body and equipment for victory, such as cycling, bobsleigh, tennis, skating, skiing – and that without even mentioning motor sport! Compared to the Olympics in 1896, performance in different sports has increased by 24 to 221% [3]. Biomedical and tissue engineering fields (which are also directly reliant on advances in materials) are equally important when sports injuries are concerned. Of course, it is not right to attribute the boost in performance of athletes entirely to materials: many other core factors that should be considered include training techniques, biomechanics, nutrition, and performance tracking. Nevertheless, as it is now well beyond debate that materials played a key role in advancing sports performance, this Special Issue of *Materials & Design* has been commissioned and devoted to this particular topic, in line with the journal scope and editorial preferences described in the Editorial Note [4].

With the above background and the intention of bringing together the most recent scientific/technological advances in materials, product design/development and sport science onto a single venue for exchange and discussion, the Institute for Sports Research (ISR¹) at Nanyang Technological University (NTU) organized the

¹ ISR is an international collaboration between NTU Singapore and Loughborough University, United Kingdom.

1st International Conference in Sports Science & Technology (ICSST). This was held in Singapore on the 11th and 12th of December 2014. Sport science platform covered physiological, biomechanical and psychological strategies aimed at improving the athletic performance, and discussed how technology could aid these strategies. Sports product engineering platform covered various aspects of design and analysis of sports equipment. The articles in the 'Materials in Sports' issue arose from the presentations made at the 'Symposium on Advanced Materials for Sports Technology'.

Specific topics covered by the peer-reviewed articles in this Special Issue demonstrate the wide variety of the application of advanced materials in sports. This diversity, in particular, is a good sign for the future of sporting industry. Editors highlight the articles discussing:

- traditional topics such as energy absorption of headgear and fracture toughness of fiber reinforced composites;
- artificial turf surfaces and the effects of friction;
- sensing (hydration and interleukin-6), environmentally responsive materials and wearable electronics;
- coatings for tribology, ice-phobicity and other smart functions;
- advanced fabrics evaluating the physiological comfort properties; and
- biological and biomimetic materials.

We hope that the readers of *Materials & Design* will enjoy reading this multi-faceted Virtual Special Issue.

Acknowledgements

The Special Issue Guest Editors express sincere appreciation to all authors and reviewers for their dedication in putting together a high quality body of joint work. Our acknowledgments are also due to *Materials & Design* editorial team and support staff for their excellent cooperation and support. Financial support from NTU Singapore towards ICSST 2014 organization is gratefully acknowledged.

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