

Assessing the Potential of Inversion Layer Solar Cells Based on Highly Charged Dielectric Nanolayers

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Supplementary materials

Table S1 shows the simulated wafer sheet resistance and calculated accumulation layer sheet resistance at various charge densities on 1 Ωcm n-type Si wafers. $R_s(\text{acc})\text{-approx.}$ was calculated according to the method described in Section 2. $R_s(\text{acc})$ was calculated by taking the reciprocal of integration of conductivity over the thickness of the accumulation layer, which is defined as where the electron concentration stops decreasing with depth. According to the table, $R_s(\text{acc})\text{-approx.}$ is significantly larger than $R_s(\text{acc})$ at low charge densities. The discrepancy becomes smaller at higher charge densities.

Table S1. Simulated wafer sheet resistance and calculated accumulation layer sheet resistance at various charge densities on 1 Ωcm n-type Si wafers.

Q (q/cm ²)	Rs(wafer) Ω/sq	$R_s(\text{acc})\text{-approx.}$ k Ω/sq	$R_s(\text{acc})$ k Ω/sq
0	49.03	--	--
2x10 ¹¹	48.96	36.34	11.30
2x10 ¹²	48.72	7.81	5.29
6x10 ¹²	48.45	4.13	3.30
1x10 ¹³	48.21	2.89	2.46
1.4x10 ¹³	47.89	2.06	1.83
1.8x10 ¹³	47.20	1.27	1.18
2x10 ¹³	46.48	0.89	0.85
2.2x10 ¹³	45.57	0.65	0.62
2.6x10 ¹³	43.76	0.41	0.40

Figure S1 shows simulated accumulation layer sheet resistance – charge density, and wafer sheet resistance – charge density curves of a 200 μm thick, 1 Ωcm , n-Si wafer with quantisation model

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being MLDA and DGM. The discrepancy between the two quantisation models here is assumed negligible in terms of using these data as an alignment with the experimental ones to develop a model, as in Figure 6.

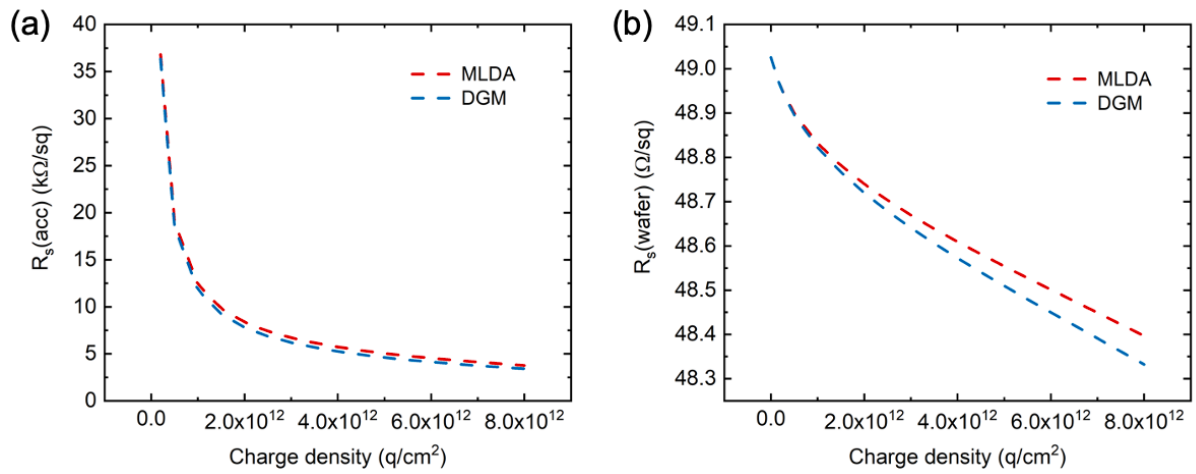


Figure S1. Simulated (a) accumulation layer sheet resistance – charge density, and (b) wafer sheet resistance – charge density curves of a 200 μm thick, 1 Ωcm, n-Si wafer with quantisation model being MLDA and DGM.

Table S2 and Table S3 show the cell parameters used for simulation of induced layer and full cells in Sentaurus TCAD.

Table S2. Summary of cell parameters used for simulation of induced layers in Sentaurus TCAD.

Parameter	Value
Wafer thickness	200 μm
Bulk base resistivity	n/p-type, 1 Ωcm
SRH bulk lifetime	$\tau_n = 0.371 \text{ ms}$, $\tau_p = 3.71 \text{ ms}$
$D_{it}\text{-midgap}$	$5 \times 10^{10} \text{ eV}^{-1} \text{cm}^{-2}$
$D_{it}\text{-tail}$	CB: $2 \times 10^{15} \text{ eV}^{-1} \text{cm}^{-2}$ VB: $8 \times 10^{14} \text{ eV}^{-1} \text{cm}^{-2}$

Table S3. Summary of cell parameters used for simulation of full inversion layer cells in Sentaurus TCAD.

Parameter	Value
Cell thickness	170 μm
Bulk base resistivity	p-type, 1/5 Ωcm
SRH bulk lifetime	1 Ωcm: $\tau_n = 0.371 \text{ ms}$, $\tau_p = 3.71 \text{ ms}$ 5 Ωcm: $\tau_n = 1.5 \text{ ms}$, $\tau_p = 15 \text{ ms}$
Finger width	25 μm
Finger spacing	600-1400 μm
SRV at front contacts	$S_n = 10^7 \text{ cm/s}$, $S_p = 10^7 \text{ cm/s}$
$D_{it}\text{-midgap}$	$5 \times 10^{10} \text{ eV}^{-1} \text{cm}^{-2}$
$D_{it}\text{-tail}$	CB: $2 \times 10^{15} \text{ eV}^{-1} \text{cm}^{-2}$ VB: $8 \times 10^{14} \text{ eV}^{-1} \text{cm}^{-2}$
$D_{it}\text{-tail}$ (with improved passivation)	CB: $10^{15} \text{ eV}^{-1} \text{cm}^{-2}$ VB: $10^{14} \text{ eV}^{-1} \text{cm}^{-2}$

