Exploiting Fixed Charge to Control Schottky Barrier Height in Si|Al_2O_3|MoO_x – based Tunnel Diodes

Supplemental: Figures

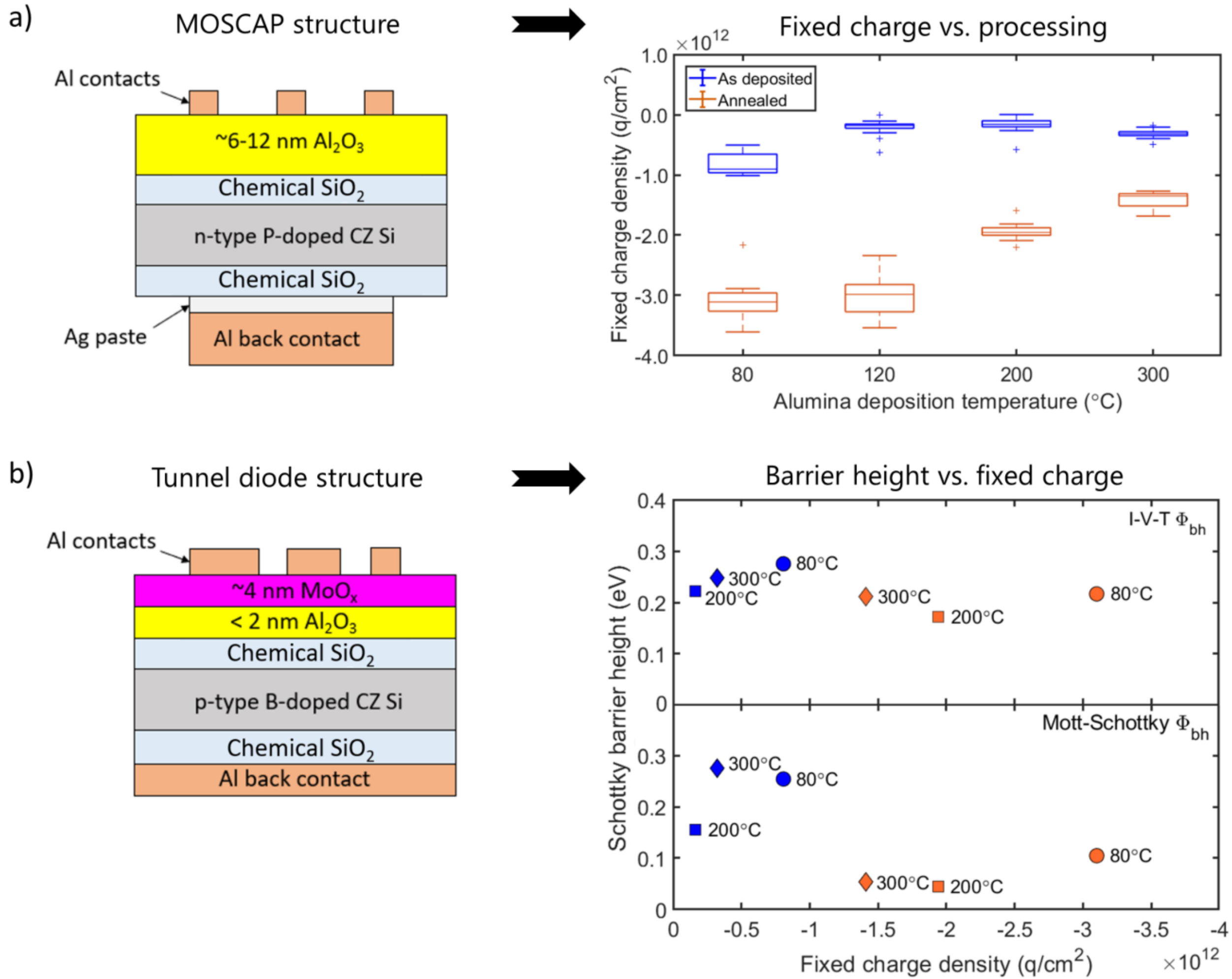

Figure 1. *(a) n-Si|Al_2O_3|Al MOSCAP structure with resulting fixed charge calculated vs. processing conditions. Fixed charge was calculated from capacitance-voltage measurements at 100 kHz. (b) p-Si|Al_2O_3|MoO_x|Al tunnel diode structure with resulting Schottky barrier height vs. fixed charge. Barrier heights were calculated from current-voltage-temperature measurements and Mott-Schottky analysis (capacitance-voltage measurements).*

Supplemental: References

[1] Battaglia, C. *et al.* Hole selective MoOx contact for silicon solar cells. *Nano Lett.* **14,** 967–971 (2014).

[2] B. E. Davis and N. C. Strandwitz, “Aluminum Oxide Passivating Tunneling Interlayers for Molybdenum Oxide Hole-Selective Contacts,” IEEE J. Photovoltaics, vol. 10, no. 3, pp. 1–7, 2020.

[3] Dingemans, G., Terlinden, N. M., Verheijen, M. A., Van De Sanden, M. C. M. & Kessels, W. M. M. Controlling the fixed charge and passivation properties of Si(100)/Al 2O3 interfaces using ultrathin SiO2 interlayers synthesized by atomic layer deposition. *J. Appl. Phys.* **110,** (2011).

[4] Hoex, B., Gielis, J. J. H., Van De Sanden, M. C. M. & Kessels, W. M. M. On the c-Si surface passivation mechanism by the negative-charge-dielectric Al2 O3. *J. Appl. Phys.* **104,** (2008).

[5] Hu, J., Nainani, A., Sun, Y., Saraswat, K. C. & Philip Wong, H. S. Impact of fixed charge on metal-insulator-semiconductor barrier height reduction. *Appl. Phys. Lett.* **99,** 1–5 (2011).

[6] Marstell, R. J. & Strandwitz, N. C. Comparison of hydrolytic and non-hydrolytic atomic layer deposition chemistries: Interfacial electronic properties at alumina-silicon interfaces. *J. Appl. Phys.* **118,** (2015).

[7] Melskens, J. *et al.* Passivating Contacts for Crystalline Silicon Solar Cells: From Concepts and Materials to Prospects. *IEEE J. Photovoltaics* **8,** 373–388 (2018).

[8] Schroder, D. K. *Semiconductor Material and Device Characterization*. *Physics Today* **44,** (2006).

[9] Terlinden, N. M., Dingemans, G., Van De Sanden, M. C. M. & Kessels, W. M. M. Role of field-effect on c-Si surface passivation by ultrathin (2-20 nm) atomic layer deposited Al2O3. *Appl. Phys. Lett.* **96,** 2008–2011 (2010).

[10] Tung, R. T. The physics and chemistry of the Schottky barrier height. *Appl. Phys. Rev.* **1,** (2014).