Opto-electronic enhancement in nano-structured thin film photovoltaic devices

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Nano-structured platforms have been explored in the context of enhanced absorption in photovoltaic systems [1, 2]. However facile fabrication of nanostructures remains a challenge. Also identification of important device length-scales over which nano-scale effects result in enhanced and combined opto-electronic performance is a problem seldom addressed. We present our work on identification of enhancement mechanisms in both the optical and electrical domains, in a proof of concept polymer photovoltaic system shown schematically in Figure 1(a). The experiments are carried out a nano-structured platforms fabricated by facile methods involving template-based moulding.

The nanostructured device are seen to result in a significantly improved photocurrent, as seen from the external quantum efficiency curves in Figure 1(b) and the enhanced absorptance of the structured architecture in Figure 1(c). We see that the enhancement in due to simultaneous improvements in optical absorptance and charge transport.

Further we also present our findings on the effects of the length scales of the various layers in the device architecture and the consequent trade-offs between nano-structured enhancement and increased parasitic losses with nanostructures. This leads to design rules for geometry and material selection in the general context of thin film photovoltaic devices. Further, our novel fabrication method opens up a simplified experimental method to make device quality nano-patterned substrates at an applied level, and studying nano-scale phenomena at the fundamental level.

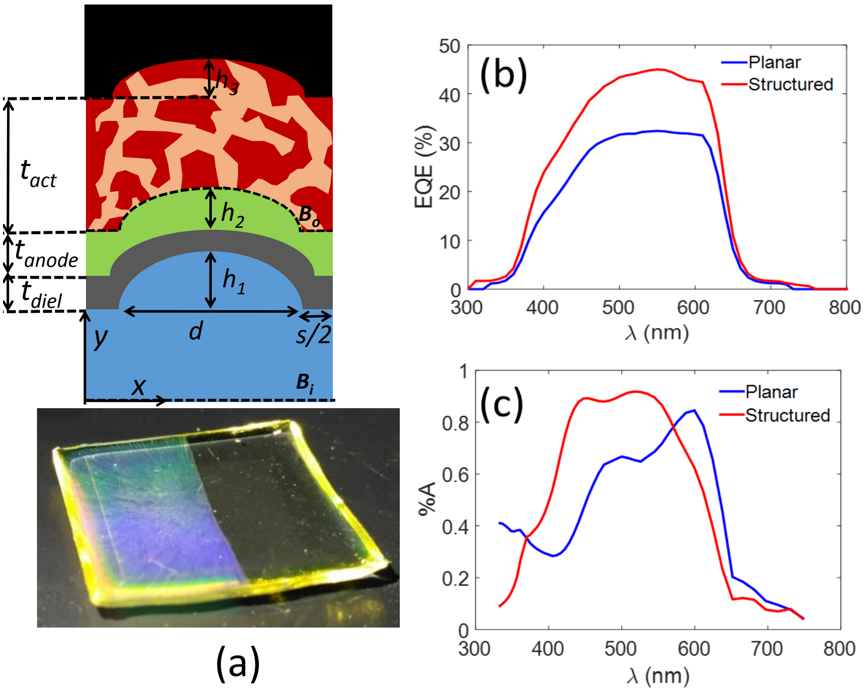

Fig. 1 (a) Schematic device architecture employed (above) and structured substrate (below), (b) External quantum efficiency of planar and structured devices, (c) Computed absorptances of planar and structured devices.

Example References
[1] S. Mokkapati and K. Catchpole, "Nanophotonic light trapping in solar cells," *Journal of applied physics*, vol. 112, p. 101101, 2012.
[2] J. Nelson, *The physics of solar cells* vol. 1: World Scientific, 2003.