Low Cost and Large Area Photonic Architectures for Enhanced Light Trapping in Solution Processed Solar Cells

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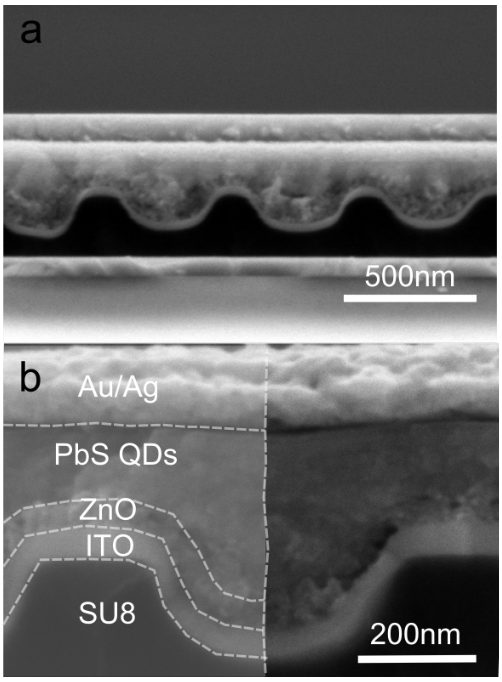
Emerging photovoltaic technologies cells (dye sensitized, organic and quantum dot based cells) focus in low cost and large area manufacturing and present typical thicknesses ranging from 100nm until several microns, imposed by efficient carrier collection constraints. Therefore, there is a necessity for new light trapping schemes that can be applied to these thin solar cells and at the same time, compatible with industrial manufacturing processes (roll to roll, solution processing, etc.). As opposed to geometric optics approaches where all light wavelengths are treated equally, emerging wave optics based structures target certain ranges where the light harvesting enhancement can be the most beneficial for the cell. Dielectric and metallic photonic architectures can enhance light matter interaction by concentrating the electric field through resonances, increasing the light optical path by diffraction and many other interesting phenomena that cannot be achieved with traditional lenses and mirrors. In this presentation, I will describe how low cost and large area photonic architectures coupled to solution processed PbS quantum dot solar cells [1] facilitate enhanced light trapping within the active layer while being fully compatible with current manufacturing processes.[2]



Cross-sectional SEM image of a ZnO-PbS solar cell built on top of an photonic electrode.

References

[1] McDonald, S. A., et al. (2005). Solution-processed PbS quantum dot infrared photodetectors and photovoltaics. *Nature Materials*, *4*(2), 138–42.

[2] Mihi, A., et al. (2014). Imprinted electrodes for enhanced light trapping in solution processed solar cells. *Advanced Materials*, *26*(3), 443–8.