ZnO NANOWIRE DYE SENSITIZED SOLAR CELLS

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The sun provides an abundant, continuous, clean source of energy that can be converted to electricity using many different photovoltaic designs. In this poster, I will present our work on nanowire dye sensitized solar cells (DSSCs), which are among the most promising of a new class of nanostructured solar cells that offer the potential for high efficiency at low cost. Conventional DSSCs use a mesostructured TiO_2 nanoparticle film, sensitized with a monolayer of organometallic dye molecules, to transport electrons to the anode by a hopping mechanism. We have replaced the TiO_2 nanoparticle film with an array of single crystal ZnO nanowires, Fig. 1(a).[1] Nanowires provide electrons with a direct path to the substrate, offering the potential for much faster charge transport than nanoparticle cells.

We have grown dense arrays of ZnO nanowires up to 8 microns long with 100 nm diameters by chemical bath deposition to investigate the effect of semiconductor morphology on DSSC performance, Fig. 1(b).[2] Increasing nanowire length increases photocurrent and efficiency with no reduction in charge collection efficiency up to nanowire aspect ratios of at least 70. Nanowire DSSCs show higher open circuit voltages than ZnO nanoparticle cells, indicating improved electron transport. Hybrid nanowire-nanoparticle cells exhibit even higher efficiencies by combining the increased light harvesting due to the nanoparticle surface area with faster transport through the nanowires.[3] Furthermore, faster charge transport allows flexibility to choose other redox couples and solid state hole transport materials that will result in more efficient and robust DSSCs.

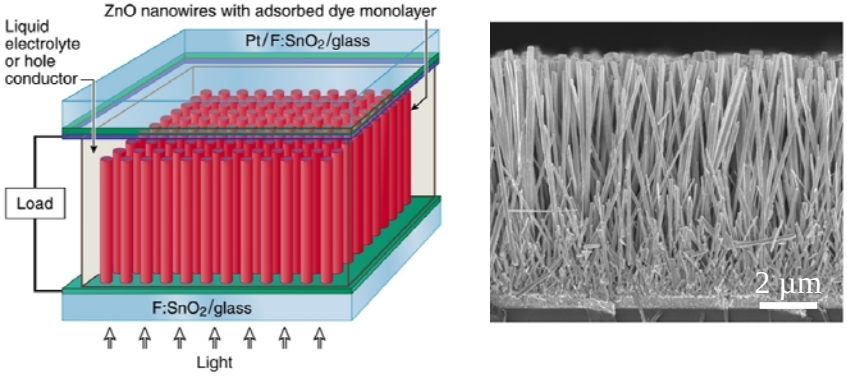

Fig. 1. (a) Schematic of ZnO nanowire dye sensitized solar cell. (b) Cross-sectional SEM image of ZnO nanowire array.

1 Baxter, J. B. and Aydil, E. S., "Nanowire-based dye-sensitized solar cells", *Applied Physics Letters* **86,** 053114 (2005).
2 Baxter, J. B., Walker, A. M., van Ommering, K., and Aydil, E. S., "Synthesis and Characterization of ZnO Nanowires and their Integration into Dye Sensitized Solar Cells", *Nanotechnology* **17,** S304 (2006).
3 Baxter, J. B. and Aydil, E. S., "Dye-sensitized solar cells based on semiconductor morphologies with ZnO nanowires", *Solar Energy Materials and Solar Cells* **90,** 607 (2006).