NANO HIGHLIGHT
Photovoltaic Devices Based on Nanoparticles and Nanowires

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While solar energy could provide enough power to satisfy the current worldwide demand, the fabrication of photovoltaic systems that are efficient and competitive with fossil fuels remains a serious challenge. To solve this problem, new strategies for solar-to-electric energy conversion are under development. We combined CdSe semiconductor nanocrystals (or quantum dots) and single-crystal ZnO nanowires to demonstrate a new type of quantum dot-sensitized solar cell (Figure 1). An array of ZnO nanowires were grown vertically on a transparent conducting glass substrate (Figure 2a). Nanometer size CdSe quantum dots (Figure 2b), capped with mercaptopropionic acid, were attached to the surface of the nanowires (Figures 2c and 2d). When illuminated with visible light, the excited CdSe quantum dots injected electrons across the quantum dot-nanowire interface. The morphology of the nanowires then provided the photoinjected electrons with a direct electrical pathway to the photoanode. Using a liquid electrolyte as the hole transport medium, quantum dot-sensitized nanowire solar cells were obtained that exhibited short-circuit currents ranging from 0.1–0.2 mA/cm^2 and open-circuit voltages of ~0.5 V.

References

[1] For further information about this project email **aydil@umn.edu**.

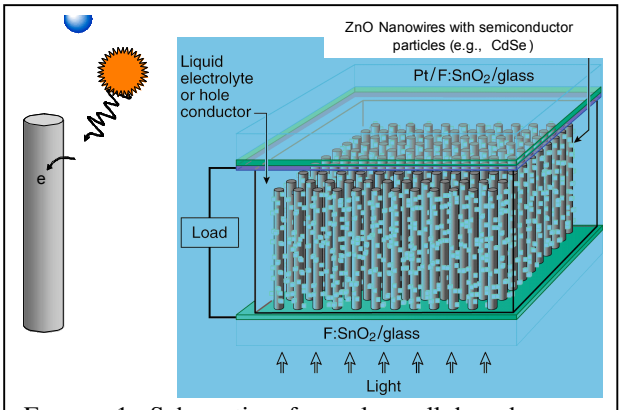

FIGURE 1. Schematic of a solar cell based on an ensemble of nanometer scale heterojunctions between nanoparticles (e.g., CdSe) and wide band gap semiconductor nanowires (e.g., ZnO).

FIGURE 2. Electron micrographs of (a) ZnO nanowires, (b) CdSe quantum dots capped with MPA (c) ZnO nanowires decorated with CdSe QDs and (d) CdSe QDs attached to a ZnO nanowire. (High resolution transmission electron microscopy is in collaboration with Prof. C. Barry Carter and his group.)