Development of Organic-Semiconductor Nanocrystal Bulk Heterojunction Photovoltaic Cells

Bhide, Parth

Semiconductor nanocrystals, including CdSe, with tunable bandgaps based on particle size offer enormous potential for solar energy collection as chromophores in bulk heterojunction polymer photovoltaics. We are considering various organic molecules, including 4-aminobenzoic acid and phenyldithiocarbamate, as potential ligands for charge transport off the nanoparticle. The ligand frame can also serve as a tether to the polymeric matrix for charge conduction. The ligand frame can be soluble in water by design in an effort to allow for facile aqueous phase self-assembly. This opens up the potential for flexible and thinner photovoltaics with a greater variety of applications as opposed to bulky monocrystalline silicon PV wafers. The nanoparticle and nanoparticle-ligand frame structure can be characterized through UV-Vis and Fluorescence spectroscopy, and the ligand through NMR spectroscopy, to determine the degree of coordination as well as the optical properties of the resulting system. Tuning the heterointerfaces with organic nanotethering offers the potential to increase photoefficiencies of the inorganic-organic photovoltaic cells.

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