

Hybrid Nanocrystal-polymer solar cells

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In recent years, the search to develop large-area solar cells at low cost has led to research on photovoltaic (PV) systems based on nanocomposites containing conjugated polymers. These composite films can be synthesized and processed at lower costs and with greater versatility than the solid state inorganic semiconductors that comprise today's solar cells. However, the best nanocomposite solar cells are based on a complex architecture, consisting of a fine blend of interpenetrating and percolating donor and acceptor materials.

We have developed a series of solar cells, in which one of the polymer components has been replaced with an inorganic nanocrystal blend, which then acts as the electron transporting medium. We have investigated such blends, using dots, rods, and branched nanocrystals. The percolation network improves in going from dots to rods to branches, resulting in better solar cell performance. In the branched crystal case, an additional benefit is realized, having to do with the ease and reproducibility of the solar cell fabrication. In typical distributed-junction cells, cell performance is strongly dependent on blend morphology, and solution-based fabrication techniques must be carefully fine-tuned to achieve composite morphologies, which are also difficult to characterize accurately. Here we incorporate 3-dimensional hyper-branched colloidal semiconductor nanocrystals in solution-processed hybrid organic-inorganic solar cells, yielding reproducible and controlled nanoscale morphology.

Further work will be described, in which cation exchange processes have been developed for preparing segmented inorganic nanocrystals, with one end for instance Cu_2S and the other CdS . Such segmented nanocrystals each can act individually as a miniature solar cell. Current work focuses on characterization of the optical and electrical properties of the individual segmented nanorods, as well as investigations into how they can be assembled into oriented and perpendicular arrays,