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Inks of Functionalized p-Type Lead Sulfide Quantum Dots for One-Step Fabrication of Heterojunction Photovoltaics

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Abstract

Heterojunction quantum dot solar cells (QDSCs) are a new and interesting kind of the low-cost and solution processable solar energy harvesting assemblies. Fabrication of such devices is accompanied by some limitations regarding to the presence of long-chain ligands on the surface of synthesized nanoparticles as well as high oxidation rate of QDs in air. Changing the surface chemistry of particles through exchange of long-chain ligands is an idea for stabilization of the QDs surfaces. This study investigates functionalization of lead sulfide QDs by short-length organic ligands and subsequent fabrication of QDSCs. In this method, inks of pre-exchanged PbS QDs were prepared through the solution phase exchange of oleate ligands with butylamine (BA) and mercaptopropionic acid (MPA) ligands. Surface chemistry of the exchanged QDs were investigated by the means of TEM and FT-IR analyses. Heterojunction solar cells of different p-type QD layers were subsequently fabricated by single-step deposition of prepared inks on FTO+TiO2 substrates and subsequent Au deposition. The power conversion efficiency (PCE) of solar cells fabricated by the ink of OA, BA and MPA-capped QDs were 0.03, 1.15 and 2.99%, respectively.

Keywords*:* Lead sulfide, quantum dots, Ligand exchange, Ink, Heterojunction solar cell.

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