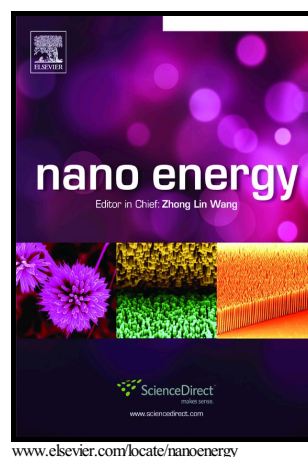


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Achieving high-performance PbS quantum dot solar cells by improving hole extraction through Ag doping

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Abstract: PbS quantum dot solar cells are promising candidates for low-cost and highly efficient light harvesting devices owing to their solution processability and bandgap tunability. The p-type ethanedithiol (EDT) treated PbS quantum dot film plays an important role in PbS quantum dot solar cells with an n-i-p junction device structure. However, despite their sulphur-rich surface the EDT-treated PbS quantum dot film still have a relatively low carrier concentration. Higher carrier concentrations in this layer are desirable to extend depletion regions and improve hole extraction. Also imbalances in the charge mobility between the intrinsic layer and the p-type layer may lead to charge build-up at this interface. These obstacles limit further improvement of the device performance. Herein, we utilize EDT-treated Ag-doped PbS quantum dots as a p-type layer to fabricate PbS quantum dot photovoltaic cells. The carrier concentration, mobility and band extrema as well as Fermi energy levels of Ag doped PbS quantum dot film can be tailored by tuning the Ag/Pb mole ratio from 0.0% to 2.0% during fabrication. The device performance has been significantly improved from 9.1% to 10.6% power conversion efficiency largely due to improvements in carrier concentration in the PbS-EDT layer through the incorporation of silver impurities.

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