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Stability Assessment of Lead Sulfide Colloidal Quantum Dot Based Schottky Solar Cell

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Lead sulfide (PbS) Colloidal quantum dots (CQDs) are promising material for the photovoltaic device due to its various outstanding properties such as tunable band-gap, solution processability, and infrared absorption. More importantly, PbS CQDs have large exciton Bohr radius of 20 nm due to the uniquely large dielectric constants that result in the strong quantum confinement. To exploit desirable properties in photovoltaic device, it is essential to fabricate a device exhibiting stable performance. Unfortunately, the performance of PbS NQDs based Schottky solar cell is considerably degraded according to the exposure in the air. The air-exposed degradation originates on the oxidation of interface between PbS NQDS layer and metal electrode. Therefore, it is necessary to enhance the stability of Schottky junction device by inserting a passivation layer.

We investigate the effect of insertion of passivation layer on the performance of Schottky junction solar cells using PbS NQDs with band-gap of 1.3 eV. Schottky solar cell is the simple photovoltaic device with junction between semiconducting layer and metal electrode which a significant built-in-potential is established due to the workfunction difference between two materials. Although the device without passivation layer significantly degraded in several hours, considerable enhancement of stability can be obtained by inserting the very thin LiF layer (<1 nm) as a passivation layer.

In this study, LiF layer is inserted between PbS NQDs layer and metal as an interface passivation layer. From the results, we can conclude that employment of very thin LiF layer is effective to enhance the stability of Schottky junction solar cells. We believe that this passivation layer is applicable not only to the PbS NQDs based solar cell, but also the various NQDs materials in order to enhance the stability of the device.

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