

Shape-Controlled $\text{CH}_3\text{NH}_3\text{PbI}_3$ Nanoparticles for Planar Heterojunction Perovskite Solar Cells

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Hybrid organic/inorganic perovskites such as methylammonium lead iodide ($\text{CH}_3\text{NH}_3\text{PbI}_3$) have been regarded as a potential candidate for thin-film photovoltaic because of their excellent cost- and energy-efficient light absorption. In this work, we have prepared $\text{CH}_3\text{NH}_3\text{PbI}_3$ nanoparticles (NPs) on the TiO_x /indium tin oxide glass substrates by using a simple spin coating method to control the size and shape of NPs. The effect of varying weight percentages (wt%) of 1-hexyl-3-methylimidazolium chloride ionic liquid (IL) have also been investigated. Analysis of the films revealed spherical $\text{CH}_3\text{NH}_3\text{PbI}_3$ NPs morphology, as shown in Fig. 1 (a, b and c), in the presence of 1, 3 and 7 wt % IL with respective diameters of 540, 350 and 600 nm. In contrary, addition of 10 wt% IL has resulted in irregular aggregation of $\text{CH}_3\text{NH}_3\text{PbI}_3$ blocks as shown in Fig. 1d, which can be attributed to the viscosity of the IL-DMF medium. Measurements Photovoltaic properties have also been conducted to understand the properties of the NPs materials in relation to increasing IL contents. It has been confirmed that the power conversion efficiency (PCE) has changed with varying $\text{CH}_3\text{NH}_3\text{PbI}_3$ NPs sizes, shapes and morphology. Optimization of the concentration with the 3 wt% of IL, we achieved $\text{CH}_3\text{NH}_3\text{PbI}_3$ NPs having more uniform shape, size, morphology which showed maximum PCE. Currently, we assume a hindering effect followed by the impact on charge dissociation, transport, and/or recombination on the device performances due to the residual IL content within the $\text{CH}_3\text{NH}_3\text{PbI}_3$ NPs. Hence, performance improvement experiments are underway to ensure the complete removal of IL-contents from the $\text{CH}_3\text{NH}_3\text{PbI}_3$ NPs films.

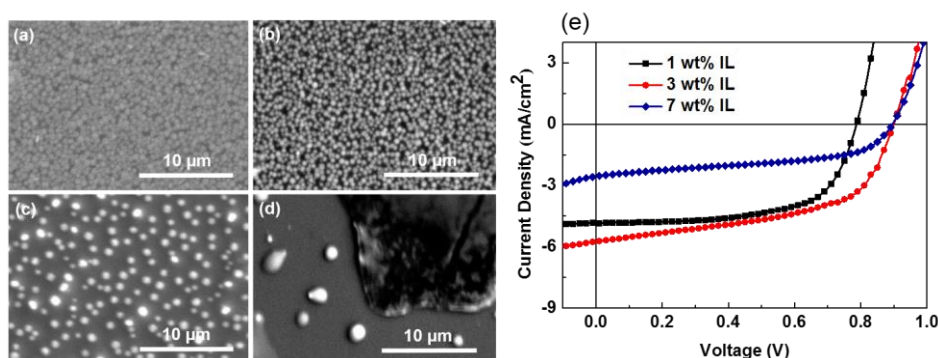


Fig. 1 The SEM images of the $\text{CH}_3\text{NH}_3\text{PbI}_3$ NPs which were prepared in the presence of varying wt% of IL: (a) 1, (b) 3, (c) 7, and (d) 10; (e) J-V characteristics processed with varying wt% of IL.

Keywords: $\text{CH}_3\text{NH}_3\text{PbI}_3$; Spherical NPs; Spin-coating method; Ionic liquid; Varying concentration