Morphology Correlated Single-Particle Optical Study of Perovskite Nanocrystals

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Organolead halide perovskites (OHPs) with the general formula A3PbX3 (A = organic cation and X = Cl, Br, I) receive a lot of attention in the field of light energy conversion due to their high absorption coefficient at visible wavelengths and long-range electron-hole diffusion. Planar perovskite-based solar cell devices consist of a thin perovskite layer deposited between conductive scaffolds and exhibit power conversion efficiencies exceeding 20%.[1, 2] Controlling the crystallinity and morphology of the perovkite layer is crucial as they influence the charge carrier dynamics as well as the performance of the devices.[3, 4]

Instead of the preparation of continuous polycrystalline perovskite films for solar cells, the fabrication of monocrystalline OHP nanocrystals is desirable. Isolated perovskite crystals represent the prototype for fundamental research on the underlying intrinsic properties, while thin films often display heterogeneities, high defect densities and low stability. Hence, new solution-processed preparation methods are applied in order to get uniform single crystals for potentially more efficient crystalline perovskite-based devices. So far, there are only a few reports on ligand-assisted solution synthesis of colloidal OHP NCs.[5-9] By adding different sets of long-chain surface capping amines and organic acids, OHP crystals like nanowires, rods, sheets and quantum dot-like particles have been obtained. However, the existing methods often suffer from (i) strong inhomogeneity in size and shape of the NCs and (ii) poor stability in suspension after purification.

Here, the morphogy controlled fabrication of organolead halide perovskites with a narrow size distrubution will be presented.[10] Upon checking the morphology by SEM, single-particle fluorescence microscopy measurements are carried out in a correlated way to obtain a deeper insight into the photoluminescence behavior of the OHP nanocrystals in different conditions.[11] Furthermore, the stability according to their morphology, chemical composition and photophysical properties is compared with previously prepared perovskite planar films.[12]

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