Perovskite Nanocrystal Assembly Formation by π–π Stacking Interaction of Ligands

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Keywords: Lead halide perovskite, Exciton, Ligand exchange, Supercrystal, Superlattice

The assembly of lead halide perovskite nanocrystals (PNCs) into superlattices (PSL) and supercrystals (PSC) gains significant attention because such highly ordered NC assemblies enhance and modulate the optoelectronic properties of the PNCs.[1] However, the formation of PSLs and PSCs remains challenging and the correlation between their structures and photoluminescence (PL) properties has yet to be identified. Previously, we demonstrated PSC preparation by bidentate ligand exchange on PNCs.[2] In this study, we report the formation of cubic $CsPbBr_3$ PNC assemblies through a ligand exchange with anthracene-based ligands and π–π stacking interactions of the ligands (Fig. 1a).

We prepare oleic acid-capped cubic $CsPbBr_3$ PNCs (Fig. 1b) using the hot injection method. In parallel, we obtain anthracene-based ligands from 9-chloromethyl anthracenes and dicarboxylic acids. PSCs are prepared by the exchange of oleic acid with the anthracene-based ligands. PSCs are settled in two days after adding the anthracene-based ligands. The PSCs have been collected by centrifugation. The scanning transmission electron microscope (STEM) image of the PSC shows well-ordered PNCs without any lattice fusion (Fig. 1c). We discuss the structure and the exciton/carrier recombination processes of the PSCs.

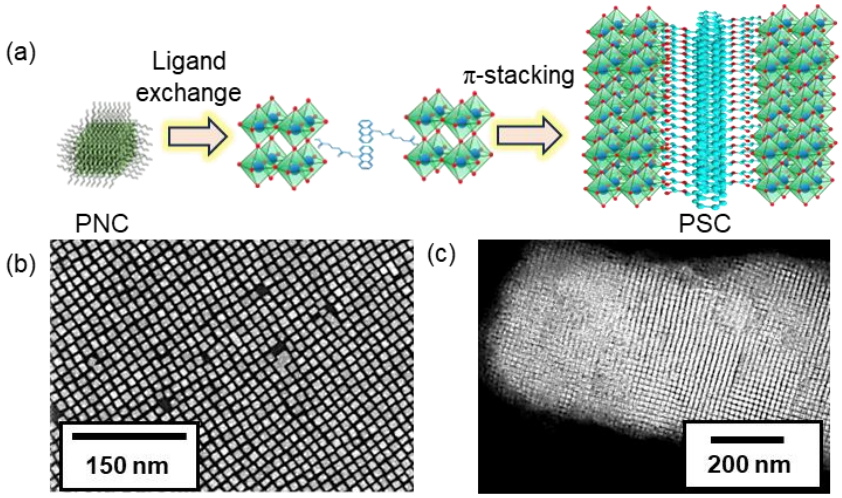

Fig. (1) A scheme of the PSC formation, (b, c) STEM images of (b) PNCs, and (c) a PSC.

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