Control of the Assembly and Optical Properties of Halide Perovskite Nanomaterials

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Halide perovskites show unique optical and electronic properties such as large absorption cross-section, size- and halide-dependent tunable bandgap, and excellent exciton and carrier transport properties. The excitonic and carrier recombination of perovskite nanomaterials can be modulated by assembly formation. However, the effects of the external stimuli-induced structural change of the perovskite nanomaterial assembly on their excitonic properties remain unexplored.

Here, we present the control of the assembly and optical properties in halide perovskite nanomaterials.[1-3] Firstly, we reported the control of the excitons and photoluminescence (PL) of self-assembled formamidinium lead bromide ($FAPbBr_3$) perovskite quantum dots (PQDs) under an applied mechanical force (Fig. 1a).[1] However, this mechano-optical modulation of the self-assembled PQDs is an irreversible process. To overcome this limitation, we demonstrated a heat-induced optical modulation of the PQD assembly in a polymer film (Fig. 1b).[2] On the other hand, the mechanical deforming of the highly ordered PQD assembly, known as supercrystals (PSCs), affects the long structural and optical stabilities. Finally, we demonstrated the formation of the slipping-free PSCs by the bidentate ligand exchange on cubic $CsPbBr_3$ PQDs (Fig. 1c).[3] These studies provide new insights into controlling the optical properties of the perovskite nanomaterial assemblies, paving the way for advanced switchable optoelectronic device applications.

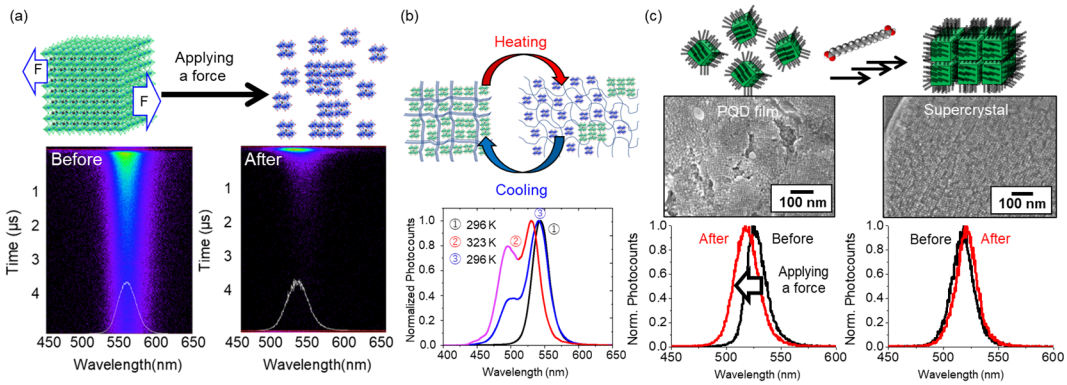

Fig. 1 (a) Mechanical force-induced optical property changes in the self-assembled PQDs. (b) Thermal modulation of excitonic recombination in the self-assembled PQDs in polymer films. (c) Slipping-free PSC formation using bidentate ligands.

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