Stoichiometry Control for the Tuning of Passivation and Phase Distribution in Green Quasi-2D Metal Halide Perovskite Films and Light-emitting Diodes

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Quasi-2D metal halide perovskite films are promising for efficient light-emitting diodes (LEDs), because of their efficient radiative recombination and suppressed trap-assisted quenching compared with pure 3D counterparts. However, because of the multi-order polycrystalline nature of solution-processed quasi-2D perovskite films and the grain boundary effect, the composition engineering always impacts the emitting properties with complicated mechanisms. Here, we systematically studied grain passivation and order distribution of quasi-2D perovskite films prepared with various recipes. As a result, in quasi-2D perovskite films prepared from stoichiometric recipes, the 2D components tend to function as passivators. In comparison, recipes of simply doping large organic halide salts into 3D perovskite films ensure not only the grain passivation, but also effective forming of quasi-2D phases, with avoiding unfavorable low-order phases. Quasi-2D perovskite films fabricated with a well-designed recipe achieved a high photoluminescence quantum yield (PLQY) of 95.3% and provided an external quantum efficiency (EQE) of 14.1% for LEDs.

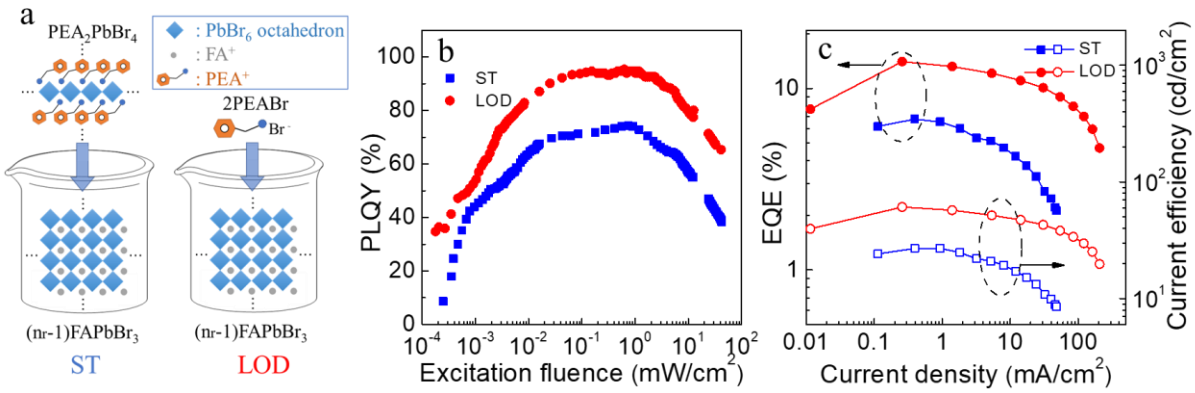

Figure a) The diagram of the precursors of perovskites with stoichiometric (ST) and large-cation-doping (LOD) recipes. **b)** The excitation power dependent PLQY of ST and LOD perovskite films with the best performances in each recipe system. c) The EQE and current efficiency versus current density of ST and LOD perovskite LEDs with the best performances in each recipe system.