Defect-filling in Lead Halide Perovskite Crystals Revealed by Single-Particle Electroluminescence Microspectroscopy

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Keywords: Halide Perovskites; Electroluminescence; Blinking; Halide Vacancy; Single-Particle Study

Lead halide perovskites emerge into a new class of semiconductor materials for potential applications to solar cells, LEDs, lasers, and photodetectors. However, photoluminescence (PL) and electroluminescence (EL) blinking caused by nonradiative losses through defects in the bandgap adversely affects the efficiencies of perovskite devices.[1,2] We clarify the mechanism of EL blinking in lead halide perovskite and understand the role of bromide vacancies in blinking.

Methylammonium lead bromide ($MAPbBr_3$) perovskite microcrystals with varying bromide composition are synthesized by using the precursors (MABr: $PbBr_2$) in the stoichiometric or under stoichiometric ratio. In a sample synthesized with the lower bromide ratio than required for $MAPbBr_3$, the EL blinking is associated with the linear power-law behavior for the ON- and OFF-time probability distributions (Figure 1a,b). On the other hand, the crystals synthesized by using a stoichiometric precursor solution shows EL blinking characterized by a truncated power-law behavior (Figure 1c,d). Single particle electroluminescence studies suggest that the trap-assisted quenching of emission and the type-B blinking dominate in a sample with higher density of halide vacancy.

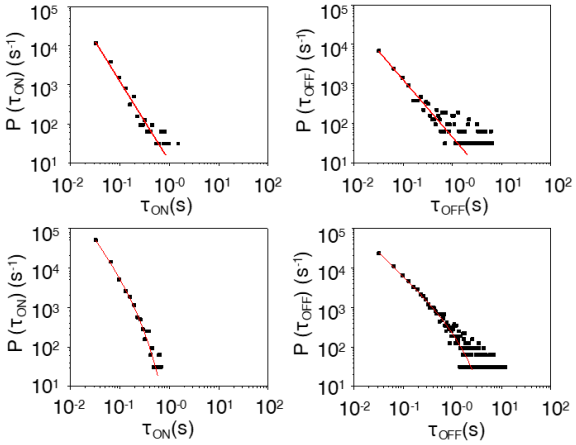

Figure 1. ON- and OFF-time probability distributions at 8V of $MAPbBr_3$ perovskite crystal prepared from precursor solutions with (a,b) under stoichiometric and (c,d) stoichiometric amounts of precursors.

1) T. Kim, *Small*. **2019**,15, 1900355. 2) D. K. Sharma, *Nat. Commun.* **2019,** 10, 4499.