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Carrier Diffusion in Metal Halide Perovskites

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Metal halide perovskites are attractive materials for the realization of cheap and effective solar cells, thin film transistors, and light emitters. Carrier diffusion at high excitations, however, is poorly addressed in perovskites, even though it governs the diffusion length and determines the efficiency of photonic devices. To fully understand the dependence of diffusion length on carrier density, we performed direct and independent measurements of the carrier diffusion coefficient and recombination rate in several lead-halide perovskite layers by applying the light-induced transient grating technique. We demonstrate the existence of two distinct carrier diffusion regimes within the density range of 1018–1020 cm–3. In the perovskite films of high compositional quality, diffusion is governed by a bandlike transport of free carriers. The diffusivity is high (0.28–0.7 cm2/s) in these samples, even at low carrier density, and further increases with excitation due to carrier degeneracy. The opposite scenario was observed in disordered perovskite layers, where diffusion is governed by hopping-like transport of localized carriers. The diffusion coefficient in latter layers is small (0.01–0.04 cm2/s at low densities) and increases with excitation due to local state filling and carrier delocalization.

主催：九州大学　最先端有機光エレクトロニクス研究センター
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