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Electron-Hole Diffusion Lengths Exceeding 1 Micrometer in an Organometal Trihalide Perovskite Absorber SAMUEL STRANKS, GILES EPERON, University of Oxford, GIULIA GRANCINI, Italian Institute of Technology, CHRISTOPHER MENELAOU, University of Oxford, MARCELO ALCOCER, Italian Institute of Technology, TOMAS LEIJTENS, LAURA HERZ, University of Oxford, ANNAMARIA PETROZZA, Italian Institute of Technology, HENRY SNAITH, University of Oxford — Organic-inorganic perovskites have shown promise as high-performance absorbers in solar cells, first as a coating on a mesoporous metal oxide scaffold and more recently as a solid layer in planar heterojunction architectures. Here, we report transient absorption and photoluminescence-quenching measurements to determine the electron-hole diffusion lengths, diffusion constants, and lifetimes in mixed halide ($CH_3NH_3PbI_{3-x}Cl_x$) and triiodide ($CH_3NH_3PbI_3$) perovskite absorbers. We found that the diffusion lengths are greater than 1 micrometer in the mixed halide perovskite, which is an order of magnitude greater than the absorption depth. In contrast, the triiodide absorber has electron-hole diffusion lengths of order 100 nanometers. Finally, we fabricated solution-processed thin-film planar heterojunction devices, achieving power conversion efficiencies of over 12% using the mixed halide absorber but only 4% with the triiodide perovskite. Our results show that the long diffusion lengths justify the high efficiency of planar heterojunction perovskite solar cells, and identify a critical parameter to optimize for future perovskite absorber development.

Samuel Stranks
University of Oxford

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