RAPID HOLE COOLING AND SLOW ELECTRON COOLING IN METHYLAMMONIUM LEAD IODIDE PEROVSKITE

MAX A VERKAMP, *Department of Chemistry, University of Illinois at Urbana-Champaign, Urbana, IL, USA*; AASTHA SHARMA, *Chemistry, University of Illinois at Urbana-Champaign, Urbana, IL, United States*; JOSH VURA-WEIS, *Department of Chemistry, University of Illinois at Urbana-Champaign, Urbana, IL, USA*.

Methylammonium lead iodide perovskite is a promising candidate for next-generation photovoltaics. One application for this perovskite is in hot-carrier collection devices. In a standard cell any excess energy from absorbed photons is lost as heat, but a cell can be designed to extract carriers before they cool to increase its efficiency above the Shockley-Queisser limit. In order to achieve this, the cooling rate of carriers must be sufficiently slower than the extraction time. Perovskite may fit this criterion due to the presence of a hot-phonon bottleneck for carrier cooling. Time-resolved XUV absorption from the core I4d level to the valence band (45-50 eV) after optical excitation (3.1 eV) was used to probe the hole distribution of photoexcited perovskite. The holes were found to cool rapidly (cooling time shorter than 400 fs) at high carrier density (10^{19} cm^{-3}). In comparison, time-resolved optical absorption (1.5-2.5 eV) was used to probe the electron distribution, which was found to cool slowly (cooling time longer than 5 ps) for the same excitation density. This indicates that a hot-carrier collection device using perovskite should be designed to only extract hot electrons, not hot holes.