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Influence of Defect States on Charge Transport in $\mathrm{CuInSe_{2-x}S_x}$ Quantum Dot Films HYEONG JIN YUN, ANDREW FIDLER, JAEHOON LIM, ADDIS FUHR, JEFFREY PIETRYGA, Los Alamos National Laboratory, SAM KEENE, MATT LAW, University of California, Irvine, VICTOR KLIMOV, Los Alamos National Laboratory, CENTER FOR ADVANCED SOLAR PHOTOPHYSICS TEAM — $\mathrm{CuInSe_{2-x}S_x}$ quantum dots (QDs) are environmental-friendly alternatives to Cd- or Pb-based QDs for solar energy applications. The key to using QD thin films in opto-electronic devices like solar cells is understanding their charge-transport properties, which are known to be influenced by defects that can serve as carrier traps. Here, we combine field effect transistor (FET) and ultrafast transient photocurrent (u-TPC) measurements to obtain a more complete picture of the nature and role of trap sates in $\mathrm{CuInSe_{2-x}S_x}$ QD thin films. FET devices employing indium contacts exhibit n-type transport with electron mobility of 5.34 10^{-4} $\mathrm{cm^2/Vs}$, but they also indicate high concentrations of electrons in the films. Early-time dynamical signatures revealed in u-TPC suggest that this high carrier density arises from the presence of trap states in $\mathrm{CuInSe_{2-x}S_x}$ QDs. In order to reduce the density of trap states, atomic layer deposition was used to infill the $\mathrm{CuInSe_{2-x}S_x}$-based devices with amorphous alumina, which results in both higher FET mobilities, and a reduction in trap-related decay signatures in u-TPC measurements.

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