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Carrier recombination pathways in Copper Indium Sulfide (CIS) nanocrystals ANSHU PANDEY, LIANG LI, JEFFREY M. PIETRYGA, VICTOR I. KLIMOV — Ternary and Quaternary compounds are rapidly gaining interest because of potential applications in areas such as thin-film photovoltaics and light-emitting diodes. We will discuss carrier dynamics in Copper Indium Sulfide (CIS) nanocrystals (NCs), one of the better studied members of the ternary-quaternary family. While as-prepared CIS NCs exhibit photoluminescence (PL) quantum yields less than 10%, overgrowth with a few monolayers of CdS or ZnS increases PL quantum efficiency to more than 80%. We investigated the reasons for this dramatic improvement in efficiency through time-resolved PL and transient absorption measurements. Our results suggest that while electrons in CIS NCs remain delocalized, the holes are rapidly localized due to trapping at defects. PL emission arises through the radiative recombination of a delocalized electron with a hole at the interior defect site (radiative decay center). We also observe surface defects that serve primarily as centers for nonradiative recombination. Overcoating of CIS NCs with CdS or ZnS eliminates surface traps and results in a long single-exponential PL decay that appears to be unique among visible-emitting NCs.

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