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Memory, Photoconductivity, and Traps in Semiconducting Nanocrystal Arrays JESSAMYN FAIRFIELD, LAUREN WILLIS, TALI DADOSH, MARIJA DRNDIC, University of Pennsylvania — Nanoscale devices are extensively studied for their tunable electronic and optical properties, but the influence of impurities and defects is amplified at these length scales and can lead to poorly understood variations in material characteristics. By performing a large ensemble of photoconductivity measurements in nanogaps bridged by core-shell CdSe/ZnS semiconductor nanocrystals, we discover optoelectronic methods for affecting solid-state charge trap populations. We show that the magnitude and temperature dependence of the photocurrent depends on the illumination and electric field history on a few-hour timescale. Subband gap illumination of nanocrystals prior to measurements modifies the photocurrent more than band gap illumination. We introduce a model that unifies previous work and transforms the problem of irreproducibility in nanocrystal electronic properties into a robust photocurrent response due to trap state manipulation. Because traps dominate many physical processes, these findings may lead to improved performance and device tunability for nanoscale applications through the control and optimization of impurities and defects.

Jessamyn Fairfield
University of Pennsylvania

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