Surface compositions, structures, and properties of surfactant-directed nanoscale semiconductors

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Advances in syntheses, molecular characterization, and modeling of nanoscale materials increasingly enable the features of nanostructured inorganic solids to be measured, understood, and correlated at a molecular level with their macroscopic physicochemical properties. This includes nanostructured semiconductors, such as zinc-chalcogenide nanocrystals and surfactant-directed hybrid photovoltaic materials, whose surface compositions and structures have important influences during their syntheses and on their subsequent macroscale opto-electronic properties. Solid-state nuclear magnetic resonance (NMR) spectroscopy, especially two-dimensional techniques, together with X-ray scattering, electron microscopy, and modeling calculations, yield detailed insights on local bonding environments, interactions, and dynamics in nanostructured semiconductor materials. Such analyses provide new understanding of structure-function relationships at the nanoscale, especially on molecular interactions at and complicated order-disorder near inorganic-organic surfaces. Recent results will be presented for Group II-VI nanocrystals and/or self-assembled hybrid photovoltaic materials, as representative examples. The influences of surface interactions and distributions of compositional or structural orderdisorder will be discussed with respect to the macroscopic properties of nanostructured semiconductors and their optoelectronic properties