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Morphology-Dependent Properties of Semiconducting SnS Nanomaterials and Evidence for a Structural Distortion at the Nanoscale ADAM J. BIACCHI, NIST, RAYMOND E. SCHAAK, Penn State, ANGELA R. HIGHT WALKER, NIST — The synthesis of semiconducting nanomaterials with controlled size, structure, and morphology using solution-based methods has emerged as an active field of research due to their excellent properties. Tin(II) sulfide is a intermediate band gap semiconductor that has received markedly less attention than other related compounds despite its non-toxic and earth-abundant constituent elements, as well as its comparably low cost and favorable electronic properties. Here we present a novel route for the solution synthesis of 2D SnS nanosheets as well as monodisperse 0D colloidal SnS nanocubes and spherical nanopolyhedra. The sheets are $\sim$ 270 nm squares with an orthorhombic crystal structure matching that of bulk α-SnS. The cubes and spherical polyhedra are $\sim$ 10 nm, below the exciton Bohr radius of SnS, allowing them to act as "quantum dots." An inability to reconcile incongruences in the diffraction patterns of the 0D nanocrystals with the 2D nanosheets leads us to propose that these SnS quantum dots crystallize in a distorted pseudotetragonal structure, which is confirmed by detailed crystallographic characterization and modeling. We interrogate the optoelectronic and photocatalytic properties of these materials to display that they are size-, shape-, and structure-dependent.

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