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Spectroscopic Determination of Structural and Electronic Properties in Solution-Synthesized Tin Chalcogenide 2D Materials ADAM BIACCHI, BRIAN ALBERDING, SUGATA CHOWDHURY, SUJITRA POOKPANRATANA, EDWIN HEILWEIL, ANGELA HIGHT WALKER, National Institute of Standards and Technology (NIST) — The vast majority of nanoscale 2D materials are synthesized by exfoliation or gas phase deposition techniques. Alternatively, bottom-up colloidal solution syntheses offer a scalable and cost-efficient means of producing 2D nanomaterials in high yield. However, routinely characterizing solution-based nanomaterials properties remain a substantial challenge due to their dimensions and the pervasive presence of surface-adsorbed stabilizing ligands. Here we present the synthesis of 2D tin chalcogenide nanomaterials and a thorough spectroscopic investigation of the inherent structural and electronic properties of individual crystals. First, we detail the development of a novel bottom-up, solution-based synthetic approach to produce nearly-monodisperse colloidal 2D metal chalcogenides of varying size and morphology. We then employ a variety of spectroscopies, ranging across the electromagnetic spectrum from X-ray to terahertz, to probe the crystallographic and electronic structure of the crystals, as well as carrier transport phenomena. These studies allow us to develop structure-property relationships among 2D materials of disparate size, morphology, and surface ligand composition when considering variances in measured band energies, interatomic vibrations, oxidation states, photoconductivity, and charge carrier mobility.

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