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Chemical Exfoliation of Layered Superconductors: An Avenue to Synthesize Boron-rich Quasi Two Dimensional Nanostructures

SAROJ KUMAR DAS, ASHA LIZA JAMES, KABEER JASUJA, Indian Institute of Technology Gandhinagar — Zero-dimensional and one-dimensional boron based nanostructures have presented excellent avenues in the past for utilizing the fascinating science of boron at the atomic level. The research on synthesizing two-dimensional (2-D) boron-based nanostructures is currently in its incipient stages. In this talk, we demonstrate two chemical approaches that yield quasi 2-D boron-rich nanostructures by enabling an exfoliation of a layered boron-based superconductor. While one approach employs the simple tool of ultrasonication in an aqueous phase, the other approach utilizes a chelation mediated strategy based on coordination of metal ions and organic ligands. Both these synthetic routes are shown to result in a processable colloidal dispersion of nanosheets. This talk will present details of the two exfoliation approaches and a comprehensive study of the morphological, chemical and optical properties of the dispersed nanosheets. We will demonstrate that the exfoliated nanosheets undergo an in-situ chemical modification with ionizable functional groups derived from solvent that enable electrostatic stabilization. We will further show that this functionalization modifies the band structure of the nanosheets which gives rise to photoluminescence and result in physico-chemical properties distinct from the parent superconductor. This ability to synthesize quasi 2-D boron rich nanostructures significantly adds to the current state of literature on boron-based quasi-planar nanostructures.

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