Solution Processing of Low-dimensional Materials and Applications

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Low-dimensional Materials like graphene, transition metal dichalcogenides, h-BN, transition metal oxides and layered double hydroxides possess the potential for applications across various fields. Liquid phase exfoliation of these layered crystals enables the solution processing of dispersions of mono- and few-layers, and provides a scalable viable alternative to other physical and chemical routes. The quality of the dispersions and their applicability are dependent on the exfoliation and stabilization of the exfoliated material by the solvent, often chosen on the basis of Hansen solubility parameters (HSP). In this work, the factors at play in liquid phase exfoliation besides HSP are explored via various experimental methods, in order to further enhance the versatility of the process by providing a deeper insight. By considering molecular aspects of the solvents, highly concentrated nanosheet dispersions were obtained in a low boiling point solvent. I will also discuss about experimental determination of the HSP of layered materials. I will be concluding my talk by discussing some of our recent efforts in exfoliating non-layered materials and applications of the 2D dispersions in various fields like flexible electronics, energy storage/conversion devices and electrochemical biosensors.

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