Direct Exfoliation of Graphite in Organic Solvents: Effect of Ionic Compounds as Intercalants

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Graphene has been recently attracted as a next-generation electronic nanomaterial due to its exceptional electrical, mechanical, and thermal properties finding its potential application in many fields. Several techniques have been developed to synthesize graphene including the mechanical exfoliation of graphite, the reduction of graphene oxide (GO), chemical vapor deposition of graphene, and the solution-phase exfoliation of graphite. Large-scale high-yield processing methods need to be developed for industrial graphene applications. The reduction of GO in aqueous environments has been widely used to produce graphene sheets on the large scale. However, this method suffers from the poor electrical conductivity of the produced graphene because the oxide functionalities in GO can't be completely removed by reduction. A significant number of defects remain in the produced graphene to disrupt the band structure and degrade the unique electronic properties of graphene. In this work, we have investigated the effect of ionic compounds as intercalants on the exfoliation of graphite in organic solvents. We have systematically examined the effect of cations and anions on exfoliation efficiency. Anions are found to affect exfoliation of graphite more significantly than cations. The prepared graphene flakes are characterized by UV-Vis spectroscopy, atomic force microscopy (AFM), Raman spectroscopy and high-resolution transmission electron microscopy (TEM). The concentration of graphene, a measure of exfoliation efficiency, is determined by a pre-weight method after vacuum filtration by a polymer membrane.