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Few-layer graphenes from ball-milling of graphite with triazine derivatives

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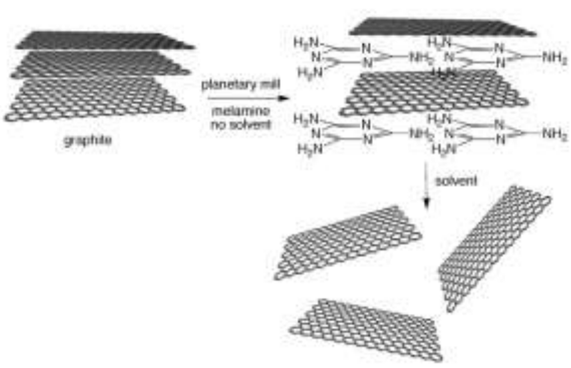
Of the different approaches to produce graphene, the solution-phase techniques [1] present several advantages, because stable suspensions of graphene can be used for various processing of the material such as film deposition, surface modification and chemical functionalization, all of which play a crucial role in exploring their applications. The exfoliation of graphene into solution requires breaking the enormous van der Waals-like forces between graphite layers. Molecular adsorption on the surface of graphene is a key step to compensate the attractive interactions between the graphene sheets. [2] Recently, careful calculations have suggested that aminotriazines are strongly adsorbed on graphite. [3] These compounds are particularly attractive, because they offer a combination of unusually strong adsorption and predictable interadsorbate hydrogen bonding which result in the creation of 2D molecular assemblies on graphite. Charge transfer from graphene to aminotriazines seems to occur in part through the presence of hydrogen atoms in the substituents

Recently, we have shown that solid phase techniques together with mechanical activation by milling processes can be used to prepare scalable quantities of functionalized carbon nanostructures.[4] Others have used ball milling to solubilize nanotubes through the formation of complexes between carbon nanotubes and various substrates,[5] while wet ball milling (DMF) has produced few layer graphene in solution.[6] All these results suggest that mechanical activation is a very promising way for modifying carbon nanostructures.

Herein, we report a simple, practical scalable procedure to produce few-layer graphene sheets using ball-milling. Large quantities of inexpensive materials like graphite and melamine can be used for massive and fast production of few layer graphenes with a low concentration of defects. The methodology opens the way for an alternative and efficient processing of graphene materials, such as film deposition and chemical functionalization [7].



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