The True Amphipathic Nature of Graphene Flakes: A Versatile 2D Stabilizer

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Abstract

The fundamental colloidal properties of pristine graphene flakes remain incompletely understood, with conflicting reports about their chemical character [1,2,3,4,5], hindering potential applications that could exploit the extraordinary electronic, thermal, and mechanical properties of graphene. Here [6], the true amphipathic nature of pristine graphene flakes is demonstrated through rigorous quantum-mechanical, molecular dynamics and Monte Carlo studies. These are supported by precise experimental chemistry, optical and electron microscopies. In contrast to commonly used graphene oxide flakes, pristine graphene flakes possess well-defined hydrophobic and hydrophilic regions in the basal plane and edges, respectively. These properties allow small flakes to be utilized as stabilizers with an amphipathic strength that depends on the edge-to-surface ratio. The interactions between flakes can be also controlled by varying the flake thickness and the oil-to-water ratio. Our findings reconcile all previous results on the chemical nature of graphene flakes. In addition, it is predicted that graphene flakes can be efficiently used as a new generation surfactants that is active under high pressure, high temperature, and in saline solutions, greatly enhancing the efficiency and functionality of applications based on this material.

References

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Figures