

Screening of solvents for 2D materials exfoliation using nanoindentation

Zainab Alkharusi^{1,*}, A. Forrest¹, I. Kinloch¹, B. Derby¹

1. Department of Materials, University of Manchester, Oxford Road, M13 9PL, Manchester, UK

*zainab.alkharusi@postgrad.manchester.ac.uk

The selection of appropriate solvents for the exfoliation of 2D materials from their bulk form mostly rests on semi-empirical correlations with surface energy terms [1],[2]. Herein, we present a method based on nanoindentation for the rapid screening and selection of solvents for the exfoliation of graphene and other 2D materials through measuring the first recorded pop-in on loading. The analysis of the load-displacement curves of nanoindentation on highly oriented polycrystalline graphite (HOPG) immersed in solvents show that the minimum average first pop-in depends on solvent composition. Figure 1a shows that with the solvent NMP (a standard exfoliation solvent) the mean stress for first popin is 4.58 ± 0.81 mN. Further investigation using solvent mixtures of isopropyl alcohol/water and ethanol/water at different ratios mix with water showed a minimum in the pop-in load occurring at or close to the solvent composition that showed the most effective exfoliation following ultrasonic bath sonication (figure 1-b,c). A similar correlation is seen between nanindentation of MoS₂ in IPA/ water mixture with the optimum composition at 40% IPA (figure 1-d).

References:

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