Fish DNA: a sustainable surfactant towards scalable production of highly water-soluble and flame-retardant graphene

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Abstract

Due to having phosphorus and nitrogen containing compounds, Deoxyribonucleic Acid (DNA) has been recently found to be an efficient renewable and environmentally-friendly flame retardant. In this work, for the first time, we have used waste DNA from fishing industry to synthesize DNA-functionalized graphene. General structure of DNA consists of sodium phosphate backbone groups, deoxyribose unites, and nucleobases having hydrogen bondings together, which potentially can be used as a surfactant for mechanical exfoliation of graphite. DNA-functionalized graphene has been synthesized through ball milling of the DNA powder and graphite using high energy ball milling over 24 h. Highly delaminated graphene nanosheets with diameter about 500 nm with an average thickness of 2-6 nanometre (>80%) were achieved. The results show a high degree of functionalization, reaching about 16 wt% DNA grafting, and a relatively high surface area of 180 m^2/g. DNA-graphene water dispersion was also stable over a week in a concentration of 2 mg/ml, demonstrating highly hydrophilic property of DNA-graphene.

References

[1] Alongi, J. et al. Journal of Materials Chemistry A 1 (2013) 4779.
[2] Wang, L., Yoshida, J., Ogata, N., Sasaki, S. & Kajiyama, T. Chemistry of Materials 13 (2001) 1273.
[3] Zabihi et al. Scientific Reports 6 (2016) 38194.

Figures

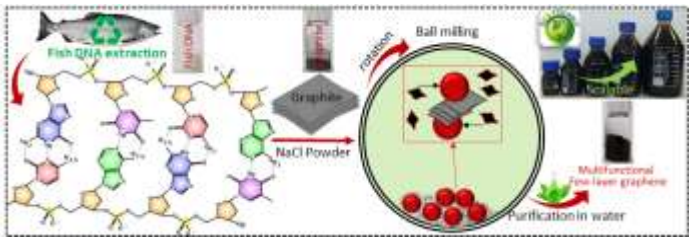

Figure 1: general procedure in synthesizing of DNA-graphene

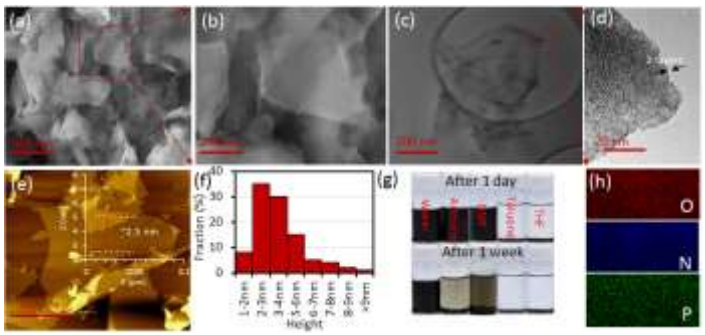

Figure 2: SEM (a & b); TEM (c & d); AFM (e & f); dispersion stability (g); and elemental mapping (h) of DNA-graphene.

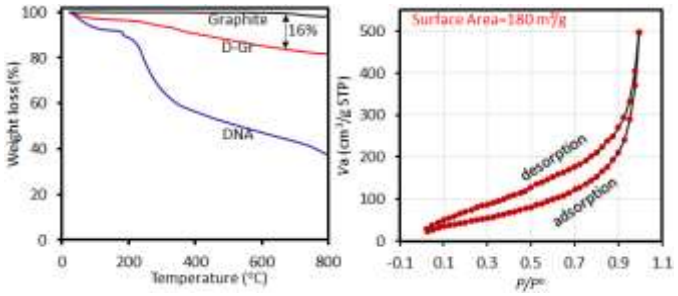

Figure 3: TGA thermograms (left) and BET measurement (right).