Exoelectrogens leading to precise reduction of graphene oxide

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Abstract

Graphene is an adept material with applications ranging from electronics to biosensors. Mass production of graphene in a cost effective manner has been a major challenge for utilizing the full potential of this excellent material. In the present study, reduced graphene oxide (RGO) has been prepared by a simple, cost effective green biological route. In this work, graphene oxide (GO) has been reduced using gram negative facultative anaerobe *S. dysenteriae* having exogenic properties of electron transfer. Apparently, different concentrations of GO were successfully reduced with almost complete mass recovery. Effective role of lipopolysaccharides has been observed while comparing RGO reduced by gram negative *S. dysenteriae* and gram positive *S. Aureus. Bacterially reduced* RGO (*Br*-RGO) prepared in our work has been characterized by X-Ray diffraction, Zeta potential, X-ray photoelectron spectroscopy and Raman spectroscopy techniques and results were found to be in good agreement with chemically reduced GO. As agglomeration of RGO is a major issue to overcome while chemically reducing GO [1], we observed that *Br*-RGO prepared in our work has zeta potential value -26.62mV, good enough to avoid restacking of *Br*-RGO. Figure 1 presents fourier-transform infrared (FTIR) spectra of GO and *Br*-RGO recorded using KBr as reference. FTIR results confirmed the efficient reduction of GO in presence of *S. dysenteriae* cells, indicated by a significant decrease in the intensity of peaks corresponding to various oxygen functionalities due to removal of partial carboxyl, hydroxyl and epoxide groups from GO and also due to cracking of aromatic C=C bonds [2]. Our results lead to a path that microbe with redox potential has a promising impendence to reduce GO. With this study it is shown that lipopolysaccharide along with exoelectrogens are responsible for reducing GO in gram negative bacterial cells. This was a successful attempt to use green biological route for reduction of GO, which is otherwise done using hazardous chemicals.

References

[1] Stankovich S, Dikin DA, Piner RD, Kohlhaas KA, Kleinhammes A, Jia Y, Carbon, **45** (2007)1558

[2] Li D, Muller MB, Gilje S, Kaner RB, Wallace GG. Nature Nanotechnology, **3** (2008)101

Figures

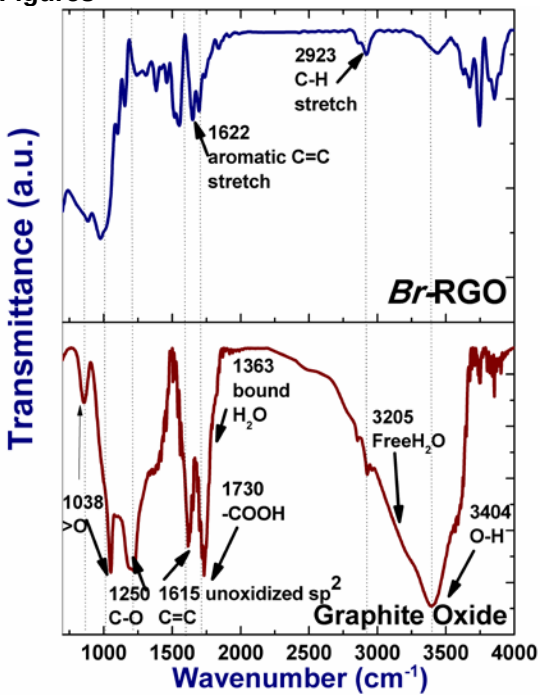

Figure 1 FTIR spectra of Graphite Oxide and *Br*-RGO reduced by *S. dysenteriae* cells.