

Structural Analysis of Plasma Exfoliated Graphene Nanoplatelets (GNPs) for the Development of Nano-Cementitious Composites

Muhammad Ilyas¹
Mizi Fan and Zhaohui
Huang²

College of Engineering Design and Physical Sciences,
Brunel University,
Uxbridge, Middlesex, UB8 3PH, London, UK
Organization, Address, City, Country

muhammad.ilyas@brunel.ac.uk

Abstract

Graphene and its derivatives, especially graphene oxide (GO), gained much attention for its use in cementitious matrix to improve mechanical properties of cementitious composite. GO is widely synthesized by chemical surface modification using modified Hummer's method in recent years. The chemical surface modification techniques generally use harsh chemicals and acid which may degrade the structural and mechanical properties of graphene. Plasma exfoliation is a new sophisticated technologically enhanced method for graphene synthesis and functionalization without using any harsh chemicals. Plasma exfoliated graphene nanoplatelets (GNPs) functionalized with $-O_2$, $-NH_2$ and $-COOH$ chemical groups were dispersed into the cement matrix for the development of nano-cementitious composite. The dispersion and interfacial interaction of GNPs with cement matrix entirely depends upon its structural and morphological characteristics. Therefore, these GNPs were analyzed for structural, morphological, surface functionality, chemical composition and disorder in crystal structure by using various characterization techniques such as HR-TEM, SEM, AFM, XRD, FTIR and RAMAN before harnessing them into the cement matrix. From the characterization data these GNPs seems promising candidate for the development of nano-cementitious composite due to its well defined honeycombed lattice structure with interlayer spacing of 0.20 nm (Fig.1), high aspect ratio, high surface energy due to I_D/I_G ratio in between 0.05 and 0.70 (Fig.2) and well dispersion capabilities in the aqueous solution.

References

- [1] Naebe, M., Wang, J., Amini, A., Khayyam, H., Hameed, N., Li, L.H. and Fox, B. 'Mechanical property and structure of Covalent Functionalised Graphene/epoxy Nanocomposites', Scientific Reports, 4.(2014)

Figures

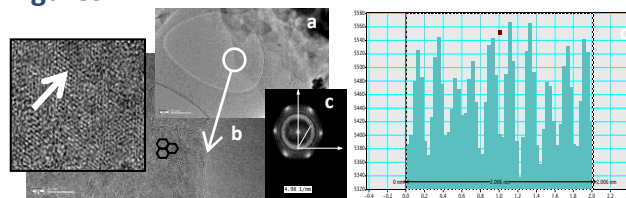


Figure 1. HR-TEM image of GNPs (a) single layered G-O2 on Cu grid (b) HR-TEM of the area spotted with white circle in fig.1a (c) FFT of G-O2 for analysis of spacing between lattice planes and (d) intensity profile taken along the white arrow shown in top left inset Fig.1b.

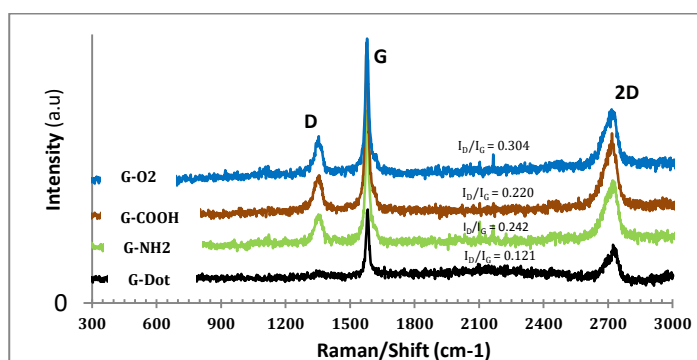


Figure 2. Combined RAMAN spectrums of G-Dot and G-Fnt. indicating I_D/I_G ratios of GNPs in between pure graphite (0.05) and GO (0.70) [1]