Contribution (Poster)

Preparation of Graphene Sheets from Expandable Graphite and Their Utilization in Ceramic-Matrix Composites

Yasemin Çelik, Ender Suvacı

Anadolu University, Department of Materials Science and Engineering, Eskişehir, Turkey
ybozkaya@anadolu.edu.tr

Graphene is a promising material in the field of composites due to their unique electrical, thermal and mechanical properties. It has attracted researchers' attention especially in polymer-matrix composites. However, the number of studies which utilize graphene in ceramic-based composites is limited [1-3].

Chemical exfoliation routes provide high yield of graphene for the composite applications. Expandable graphite is a widely used precursor material for the preparation of graphene sheets by chemical exfoliation. It can be easily prepared by intercalation of various species, such as sulphuric acid, between the layers of readily available graphite flakes [4].

In the present study, graphene sheets were prepared from expandable graphite and then utilized for the production of graphene/Al_2O_3 composite systems. The expandable graphite was kindly provided by Asbury Carbons (Expansion ratio: 307, Grade 3772, Lot 7335-3). After drying in a vacuum oven, it was subjected to a heat treatment at 900°C for 2 min. The as-obtained expanded graphite was then exfoliated into graphite/graphene sheets in 1-methyl-2-pyrrolidone (NMP, Merck-Emplura) by a low power sonication and large graphitic flakes were removed by a subsequent centrifugation at 600 rpm for 45 min. The resulted graphene sheets were incorporated into an α-Al_2O_3 powder (Taime TM-DAR) and sintered by spark plasma sintering at 1300-1500°C. Phase analyses of the expanded and exfoliated graphite samples and graphene/Al_2O_3 composites were performed by X-ray diffractometer (XRD, Rigaku Rint 2200, Tokyo, Japan) with CuKα radiation. The morphology of these samples was examined by field-emission-gun scanning electron microscopy (FEG-SEM, Zeiss Supra 50 VP). Besides the critical parameters in the production of graphene sheets from expandable graphite, the electrical conductivity and mechanical strength of the prepared graphene/Al_2O_3 composites will also be discussed in this presentation.

References

[1] Wang, K., Wang, Y., Fan, Z., Yan, J. and Wei, T., Preparation of graphene nanosheet/alumina composites by spark plasma sintering, Mater. Res. Bull. 46 (2011) 315-318

[2] Fan, Y., Wang, L., Li, J., Li, J., Sun, S., Chen, F., Chen, L., Jiang, W., Preparation and electrical properties of graphene nanosheet/Al_2O_3 composites, Carbon 48 (2010) 1743-1749

[3] Walker , L.S., Marotto, V.R., Rafiee, M.A., Koratkar, N., and Corral, E.L., Toughening in graphene ceramic composites, Acsnano, 5[4] (2011) 3182-3190

[4] Gu, W. *et al.*, Graphene sheets from worm-like exfoliated graphite, J. Mater. Chem., 19 (2009) 3367-3369