Synthesis of graphene oxide – Fe_3O_4 nanoparticles hybrid

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Abstract

Graphene is a one – atom – thick planar sheet of carbon atoms densely packed in a honeycomb cristal lattice. Due to its exceptional electronical, physical, chemical and mechanical properties, graphene, graphene oxide and reduced graphene oxide have been extensively studied for a variety of applications in biomedicine[1-3]. Monolayer of carbon atoms, two dimensional structure and high specific surface area make it a perfect potential carrier for a large number of substances, e. g. biomolecules, drugs, ferromagnetic nanoparticles. Magnetite (Fe_3O_4) has been widely used in various fields such as targeted drug delivery, hyperthermia, magnetic resonance imaging because of its magnetic and electrochemical properties [4-5].

We report a facile method for the preparation of graphene – oxide – Fe_3O_4 nanoparticles hybrid. The surface of iron oxide was modified with oleic acid. The carboxylic groups on the graphene oxide surface were activated with *N*-Hydroxysuccinimide (NHS) and 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide (EDC). The mixture of modified iron oxide and graphene oxide was stirred for 48 h. Transmission electron microscopy (TEM), atomic force microscopy (AFM), Fourier transform infrared spectroscopy (FT – IR), thermal gravimetric analysis (TGA) and X – ray diffraction technique (XRD) were used to characterize the obtained product. The XRD pattern of graphene oxide – Fe_3O_4 hybrid is presented in Fig. 1. It shows reflections consistent with the magnetite which is known for its magnetic properties. Fig. 2 presents the TEM image of graphene – oxide – Fe_3O_4 nanoparticles hybrid.

References

[1] Liu, Z., Robinson, J. T., Sun, X., and Dai, H., J. Am. Chem. Soc., **130** (2008) 0876 – 10887.
[2] Zhang, Y., Nayak, T. R., Hong, H., and Cai, W., Nanoscale, **4** (2012) 3833 – 3842.
[3] Wang, Y., Li, Z., Wang, J., Li, J., and Lin, Y., Trends in Biotechnology, **29** (2011) 205 – 212.
[4] Yang, X., Zhang, X., Liu, Z., Ma, Y., Huang, Y., and Chen, Y., J. Phys. Chem. C, **112** (2008) 17554 – 1 7558.
[5] Yu, M. K.; Jeong, Y. Y.; Park, J.; Park, S.; Kim, J. W.; Min, J. J.; Kim, K.; Jon, S. Angew. Chem., Int. Ed., **47** (2008) 5362.
[6] Larsen, E. K. U.; Nielsen, T.; Wittenborn, T.; Birkedal, H.; Vorup – Jensen, T.; Jakobsen, M. H.; Ostergaard, L.; Horsman, M. R.; Besenbacher, F.; Howard, K. A.; Kjems, J., ACS Nano, **3** (2009) 1947.
[7] Geim, A. K.; Novoselov, Nat. Mater., **6** (2007), 183 – 191.
[8] Park, S.; Ruoff R.S., Nat. Nanotechnol., **4(4)** (2009) 217 – 24.
[9] Rao, C. N. R.; Sood, A. K.; Subrahmanyam, K. S.; Govindaraj, Chem., Int. Ed., **48** (2009) 7752 – 7777.

Figures

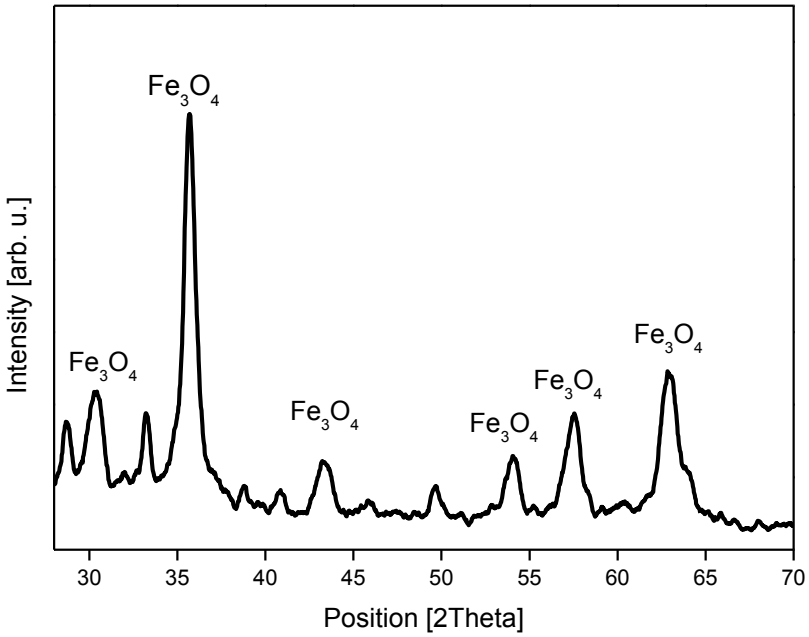

Fig.1. XRD pattern of graphene – oxide – Fe_3O_4 nanoparticles hybrid.

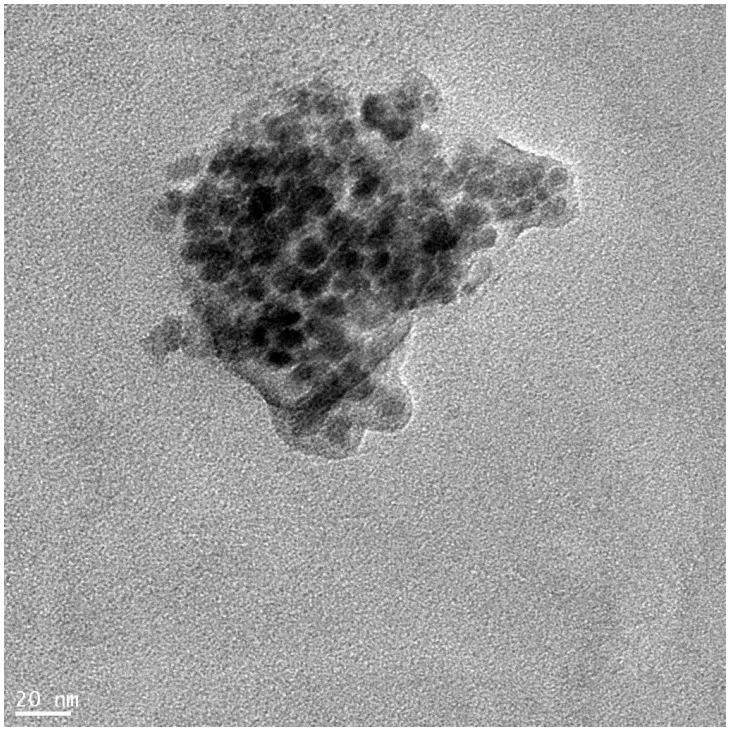

Fig. 2. TEM image of graphene – oxide – Fe_3O_4 nanoparticles hybrid.