Structure and magnetic properties of iron nanoparticles encapsulated in graphene (INPEGs)

Oleksandr Bieda[a, b], Serhii Knutarev,[a] Gerardo Algara-Siller,[c] Bartłomiej Andrzejewski[d]

[a] *Research and Development Department, TMM LLC, Volodymyrska str. 49a, 01601 Kyiv, Ukraine*
[b] *Kyiv National Taras Shevchenko University, Chemistry Department, Lva Tolstogo str. 13, 01601, Kyiv, Ukraine*
[c] *Inorganic Chemistry Department, Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6 D 14195, Berlin, Germany*
[d] *Institute of Molecular Physics Polish Academy of Sciences, Mariana Smoluchowskiego str. 17 60-179 Poznań, Poland*
a.byeda@gmail.com

Carbon-covered iron nanoparticles (CCINPs) are produced by arc-discharge method from graphite anode filled with bulk iron with consequent condensation on magnetic meshes in low-pressure argon atmosphere. The product contains mostly two types of CCINPs by size: 3-8 nm iron nanoparticles encapsulated in graphene (INPEGs) and 40-60 nm iron nanoparticles covered with defective carbon layers (Fig. 1). The former are insoluble in boiling HNO_3(conc.) and, thus, can be isolated. According to differential thermogravimetric (TGA) studies the carbonic component of the material is stable to air oxidation up to 820 °C, while large part of iron is accessible for oxidation on air under heating to 400 °C. TEM and Raman examination demonstrate that iron nanoparticles in INPEGs are averagely covered with 2 layers of graphene. Size of iron core in CCINPs is below critical size of magnetic domain, so both CCINPs and INPEGs demonstrate superperamagnetic properties (Fig. 2)

Figures

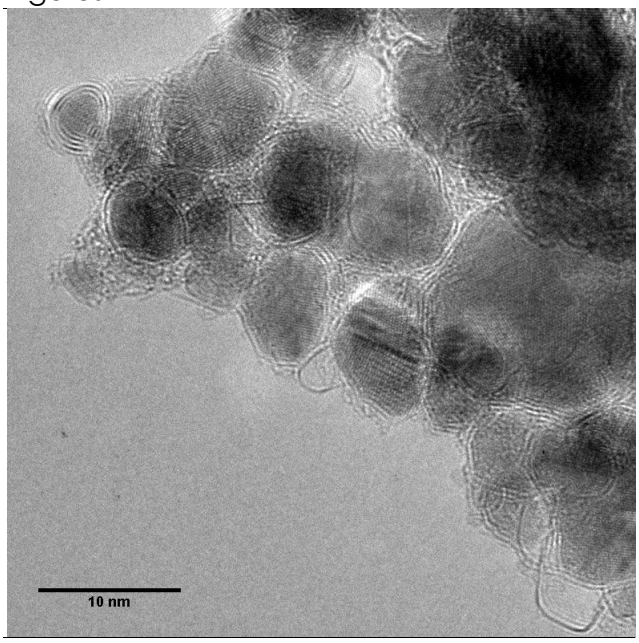

Figure 1: TEM image of INPEGs.

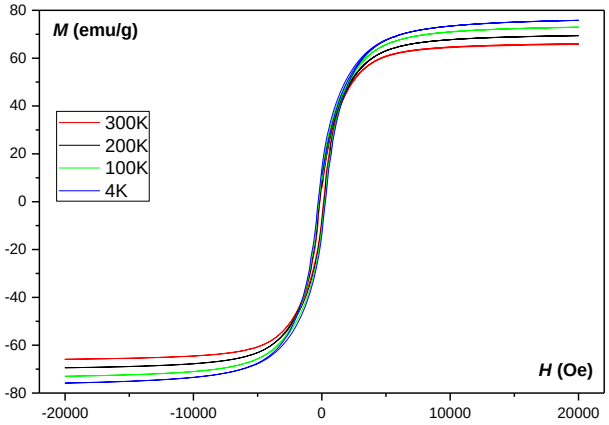

Figure 2: Magnetic properties of isolated INPEGs.