MS32.O05

Composite materials based on cerium oxide nanoparticles and graphene

M. Zaporozhets[1,2], A. Soloveva[2], A. Shalyapina[1], E. Buslaeva[2], V. Nikolaichik[3], S. Gubin[2], A. Avilov[1]

[1]Shubnikov Institute of Crystallography of the Russian Academy of Sciences, Moscow, Russia, [2]Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of Sciences, Moscow, Russia, [3]Institute of Microelectronics Technology of the Russian Academy of Sciences, Chernogolovka, Moscow District, Russia

Deposition of nanoparticles (NPs) onto graphene (G) surface is actively studied now in connection with the prospects of such composites for use in power supply and other areas. In order to increase the energy density of electrochemical capacitors the development of electrode materials consisting of carbon nanostructures and metal oxides such as CeO2, SnO2 and some others is paid attention. Carbon materials typically exhibit excellent stability and reversibility, but their capacity is limited by microstructure. Therefore, if the integration of these two types of materials is realized high capacitance stability can be attained. Synthesis of the composites was carried out in several stages. In the beginning, dispersion of graphene oxide (GO) was prepared by the Hummers's technique. Then, GO surface was precipitated with CeO2 NPs synthesized in aqueous solutions of Ce(NO3)3 and ammonia. Thereafter, the GO/CeO2 system was reduced to the G/CeO2 one in supercritical isopropanol. The obtained composites were characterized by a complex of structural and spectral methods including transmission electron microscopy (TEM), X-ray powder diffraction (XRD) and optical absorption spectroscopy. TEM has revealed that CeO2 NPs in the G/CeO2 composite form associates of a nearly spherical shape. Associates demonstrate a broad size distribution, their average size on G surface is 220 nm. High resolution TEM studies have shown that associates consist of CeO2 NPs of smaller size with an average size of ≈ 12 nm. XRD has shown the presence of two phases: ceria CeO2 with a cubic fluorite structure and graphene. The average size of CeO2 NPs estimated from the region of coherent scattering is ≈11 nm, which agrees well with the TEM data. According to UV-visible spectroscopy, absorption spectra of G/CeO2 dispersion contain an absorption band only in the wavelength range of 280-360 nm typical for CeO2. This work was supported by the grant of the President of the Russian Federation (MK-7155.2013.3).

Keywords: nanoparticles, graphene, composite materials