Electronic structure of hollow graphitic carbon nanoparticles made from acetylene carbon black

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The electronic structure of hollow graphitic carbon nanoparticles obtained by catalytic graphitization of acetylene carbon black (ACB HGCNs) was studied by ultra-soft X-ray emission spectroscopy (USXES) method. The phases of the carbon powder samples were determined by XRD with monochromatic Cu$K_{\alpha 1}$ radiation. Transmission electron microscopy was used to study the ACB HGCN spatial structures and morphologies. The electronic structures of reference Q-graphenes and HGCNs obtained from iron carbide filled carbon nanocapsules (Fe_3C@CNCs) which were synthesized by plasma method in hexane were measured for comparison with that of the synthesized ACB HGCNs.

It has been found that according to an energy-dispersive X-ray analysis the content of iron in samples was estimated at about 1.8 wt. % for ACB HGCNs. In the samples of Q-graphenes some amount of MgO, which was used for production of these samples was revealed.

Images of graphitized products obtained by transmission electron microscopy showed ACB HGCNs with different diameters ranging from 20 nm to 1 μm and shell thicknesses ranging from 4 to 50 nm.

USXES investigations revealed greater contribution of overlapping of $pp\pi$+$pp\sigma$-states in greater number of walls in HGCNs in comparison with Q-graphenes.

It has been found that in following sequence: HGCNs obtained from Fe_3C@CNCs – HGCNs synthesized by graphitization of ACB – Q-graphenes occupation of π-sub-band decreases.

USXES showed that ACB was not fully transformed into ACB HGCNs that was confirmed by XRD analysis and results obtained by transmission electron microscopy.