

Investigation of Formation of Onion-like Carbon Nanoparticles from Nanodiamonds

Popov V.A.¹, Skryleva E.A.¹, Chuvilin A.², Kaizer U.², Khodos I.I.³, Kovalchuk M.N.³, Melnikov S.A.⁴, Parshin A.P.⁴

¹STU "Moscow Institute of Steel and Alloys", Russia,
e-mail: popov58@inbox.ru

²Ulm University, Ulm, Germany

³Institute of Microelectronics Technology and High Purity Materials RAS,
Chernogolovka, Russia

⁴VNIKhT – All-Russia R&D Institute of Chemical Technology, Moscow, Russia

Nanodiamonds is perspective material for reinforcing composites with metal and polymeric matrixes [1-3] that is why investigation of structure and possible transformation of nanodiamonds is an actual task.

In this study nanodiamonds powder was annealed in vacuum furnace at temperatures from 800 up to 1600°C. High temperature annealing leads to formation of onion-like carbon from nanodiamonds particles, but shape of primary particles and agglomerates is changed slightly. Structure of nanoparticles was investigated with transmission electron microscopes TITAN (Ulm University) and JEM-2000FX (Chernogolovka), as well as by method of X-ray photoelectronic spectroscopy-XPS (MISA).

XPS shows that portion of "sp³-bound atoms" is decreasing from 98 ± 2% (initial material) to 70±5% (1000°C), 42±5% (1200°C) and 0% (1400°C) during annealing.

Electron diffraction patterns confirmed transformation of nanodiamonds into onion-like carbon at 1250°C.

Transmission electron microscope TITAN allowed receiving direct view of nanoparticles under accelerating voltage 80 kV with magnification around 2 millions times. This study showed complete transformation of nanodiamonds into onion-like carbon at 1400°C.

Investigation of transformation of nanodiamonds into onion-like carbon allows developing technological conditions of composites manufacturing.

- [1] V.A. Popov, L.S. Belevsky et al. *Journal of Alloys and Compounds* **434-435**, 689 (2007).
- [2] V.A. Popov, V.G. Kulichikhin et al. Proc. All-Russia Conf. "Physco-chemistry of ultra-disperse (nano) systems", 22-24 November 2005, Ershovo. MEPhI – p.265-266.
- [3] P.Y. Detkov, V.A. Popov, V.G. Kulichikhin, S.I. Chukhaeva. Development of Composite Materials Based on Improved Nanodiamonds. In book "Molecular Building Blocks for Nanotechnology", USA, Springer, P. 29-43 (2007).