Chemical State of C- Atoms on Modified Nanodiamond Surface

À. Dementjev[1], K. Maslakov[1], I. Kulakova[2], and V. Dolmatov[3]

[1] RRC "Kurchatov Institute", Kurchatov sq., Moscow 123182, Russia
[2] Department of Chemistry, Lomonosov Moscow State University, Leninskie Gory 1, build.3, Moscow, 119992, Russia
[3] JSC "Diamond Centre", Sovetskii pr. 33A, S.Peterburg, 193076, Russia

There is some information, that a distorted carbon shell is between diamond core and functional cover in nanodiamond (ND). The features of this shell of nanodiamonds (number of carbon layers, the ratio between carbon atoms in the sp^3- and sp^2-hybridized states) depend on detonation synthesis conditions. It's possible, that conditions of ND particles surface modification can effect not only on functional composition but on the distorted carbon shell itself.

The goal of this research was to indicate the changes of carbon state on ND surface in dependence on gas-phase treatment conditions. The study was carried out with ND type UDD-STP (JSC "Diamond Centre"). The different kinds of treatments were done: with air (5 h) at 200 and 400°C; with hydrogen (5 h) at 800, 850 and 900°C; with fluorine (48 h) at 20°C and 0.5 atm. The use of different spectral methods has provided evidence of the modification conditions influence on the chemical composition and the state of carbon atoms in the surface layer (1-10 carbon layers), and has allowed to evaluate ND particle dimension changes.

So, the XPS and AES data testify that nitrogen is present in the core mostly. Oxygen is contained on the ND particles surface both in adsorbed water and chemical connected with ND particles. The treatment with air leads to increasing the amount of chemical connected oxygen. ND treated with hydrogen doesn't affect surface properties and doesn't adsorb oxygen and carbon containing molecules from environment even after the long exposition at the air. The treatment of ND with air or hydrogen at high temperature doesn't change the chemical state of carbon atoms both on the surface and in the shell of ND particles. In the case of air treatment it was discovered the decreasing of diamond particles sizes in contrary to their increasing during hydrogen treatment.