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Stability of nano and microdiamonds to the action of heavy ions. Thermophysical properties of micro and nanodiamonds at the heating

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The point defects of the crystal lattice form under the ions irradiation. The matter structure is changing. The gradients of the concentrations of point defects and impurity atoms disrupt the thermodynamic equilibrium conditions. Implantations of ions in crystal lattice correspond to free energy increasing. This leads to the change of the phase stability. The phase transition may occur in the substance. At the irradiation with ions of the nanodiamond particles, the graphitization wave is possible. This wave will be propagate from the ion passing channel. It is suggested that critical conditions for the introduction of ions into diamond nanoparticles exist. At the conditions the crystalline lattice breaks down into an amorphous state.
In suggested experiments it is assumed to use a layered target. The energy absorbed in each target is calculated by the SRIM program. It is intended to use a target with a density of 0.37g/cub.cm, consisting of a detonation nanodiamond powder containing from 3*10^17 to 2*10^18 particles. The powder particles of the detonation nanodiamond have an inhomogeneous structure. It consists of a diamond core surrounded by a shell of non-diamond carbon and metallic impurities. The pycnometric density of particles is from 3.15 to 3.25 g/cub.cm. For each target containing nanodiamonds, after irradiation, the diamond decreasing will be determined from the results of X-ray analysis. To explain the work with the beam, we conducted preliminary studies of the thermal stability of nanodiamonds.
The thermophysical properties of the detonation nanodiamond powder were investigated by the method of synchronous thermal analysis. The investigations were carried out at atmospheric pressure in an argon flow to a temperature of 1500℃. The heat rate was 2 and 10℃/min. As a result of the work, it was found that the heat treatment of the powder up to 1500℃ with the heating rate of 10℃ significantly changed the morphological properties of the powder particles [1]. The spherical particles with a linear size of 10 to 40 nm predominate (in the initial powder the particle size was from 6 to 10 nm). A high thermal stability of nanodiamond was found up to 1500℃ [2, 3]. At the heating of the investigation material to 1500℃ with the rate of 2℃/min, the formation of plane carbon structures of the size order of 1 μm was observed in the sample. In this case, the size of the spherical particles was established on the order of 4 nm. A graphite-like X-ray amorphous phase was found by the X-ray diffraction analysis in samples after the heat treatment up to 1500℃ with the rates of 2 and 10℃/min. It corresponds to a non-graphitizing carbon structure consisting of planes whose atoms are in sp^2 state, as in graphite, but the interplanar distance is larger than in graphite.
Search for critical conditions for the existence of detonation nanodiamonds (DND). Determination of the criteria for destruction of carbon in the sp^3 phase.
References
[1] V.P. Efremov, E.I. Zakatilova, I.V. Maklashova, and N.V. SHevchenko, Konstruktsii iz kompozitsionnykh materialov 2 (2016) 48
[2] V.P. Efremov and E.I. Zakatilova, Journal of Physics: Conference Series 774 (2016) 012014
[3] S.A. Gubin, V.P. Efremov, I.V. Maklashova, and E.I. Zakatilova, V sbornike: Dostizheniya v fizike detonatsii TORUS PRESS. Moskva (2016) 343.

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