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Research into d+d Nuclear Reactions in Crystalline Structures Using an HELIS Ion Accelerator

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The study of nuclear fusion reactions involving light nuclei in crystalline structures is a significant topic for both fundamental research and practical applications. Experimental studies have demonstrated that the processes of deuterium nuclear fusion in solid and gaseous targets differ significantly. A number of experimental results have been obtained, indicating the possibility of reducing the energy required to initiate nuclear reactions in solids due to the effects of hydrogen interaction with the crystal lattice. Using the HELIS ion accelerator (Lebedev Physical Institute of the Russian Academy of Sciences, Moscow), we conducted a series of experiments to investigate d+d nuclear reactions in various crystalline structures. The energy of the deuterium ions varied from 10 to 45 keV, and the beam current ranged from 20 to 100 μ A. Scintillation detectors with organic crystals were used to register the neutrons produced in the deuterium fusion reactions. This paper presents the results of experiments on studying d+d reactions in Pt and Ti metal targets, as well as in polycrystalline CVD diamond. For the first time, similar experiments were carried out with a B4C ceramic target. The neutron yield from these targets was measured as a function of irradiation time, deuterium ion beam parameters, and target temperature. A simulation of the passage of deuterium ions through the substance of the specified targets was carried out. Based on experimental data and the modeling results, deuterium concentrations in Pt, Ti, CVD diamond, and B4C were calculated as functions of irradiation time, beam current, deuterium ion energy, and target temperature. The obtained results are presented in the report.

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