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Orientation Effect in the Neutron Yield in Deuterated Pd Target Bombarded by Deuterium Ion Beam

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At the ion accelerator HELIS at the LPI, the neutron yield is investigated in DD reactions in deuterated Pd target, during an irradiation of its surface by a deuterium ion beam with the energy 20 keV. The measurements of the neutron flux in the beam direction are performed in dependence on the target angle, β , with respect to the beam axis. These measurements are performed using a multichannel detector based on He3 counters. A significant anisotropy in neutron yield is observed, it was higher by a factor of 2 at $\beta=0$ compared to that at $\beta = \pm 30^\circ$. The possible reasons for the anisotropy, including ion channeling, are discussed. A similar effect was observed earlier when irradiated deuterated CVD diamond samples with a deuterium ion beam [1].

To explain the experimental results, we used the computer code earlier applied in [2] to interpret the orientation effect in the neutron yield from deuterated C(400) target irradiated by 20 keV deuteron beam. The code allows calculation of the deuterons flux under channeling condition. Now, the code is modified in order more exactly take into account the dependence of reaction probability on impact parameter. The dependence on impact parameter was “constructed” conjugating the classical definition of reaction cross-section (integral over impact parameters) from one side, and real yield of DD reaction from another side, which is the convolution of energy-dependent cross-section (includes astrophysical S-factor), effect of screening, and energy loss.

Reference

1. A.V. Bagulya, O.D. Dalkarov, M.A. Negodaev, A.S. Rusetskii, A.P. Chubenko, V.G. Ralchenko, A.P. Bolshakov, Nucl. Instr. and Meth B 355 (2015) 340.
2. A.V. Bagulya, O.D. Dalkarov, M.A. Negodaev, Yu.L. Pivovarov, A.S. Rusetskii, T.A. Tukhfatullin. Nucl. Instr. and Meth. B 402 (2017) 243.

Summary

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