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MODELING OF NEUTRONS GENERATION UNDER IRRADIATION WITH FAST ATOMS

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The results of modeling the neutron yield during irradiation of a TiD_2 target with deutron D^+ and deuterium atoms (D-D reaction) are presented. The neutron yield per deutron with energy E was calculated by the ratio for a thick target:

$$Y_{1D}(E) = A \int_0^{E_{max}} \frac{\sigma(E)}{dE/dx} dE, \; neutrons \qquad (1)$$

where A is the density of deuterium atoms in the target, cm^{-3}; σ(E) is the cross section of the D-D reaction, cm^2; dE/dx is the linear energy loss (LEL) of the deutron in the target, eV/cm.

Experimental values of the D-D reaction cross section [1] were used in the simulation, LEL of the deutron in the TiD_2 target was calculated using the SRIM program [2]. The results of the calculation of the LEL and the neutrons yield are shown in figure 1.

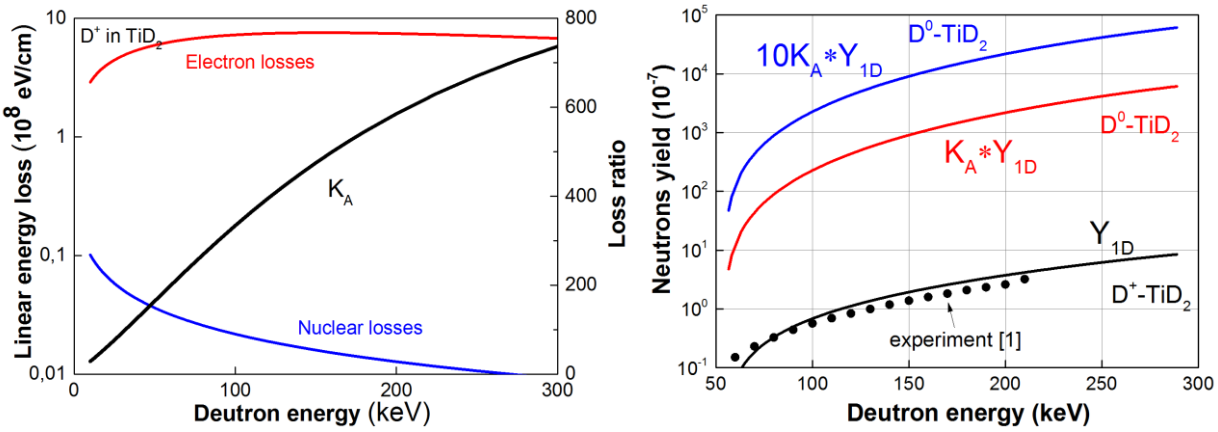

Fig.1. Dependence on the deutron energy of the LEL of the deutron in the TiD_2 target and the neutron yield per deutron in the D-D reaction

When ions are absorbed in a metal target, the main part of their energy is spent on interaction with the target electrons (electron losses), see Fig. 1. When the target is irradiated with deuterium atoms, the electronic losses are significantly less. To account for the increase in neutron yield when irradiated with deuterium atoms, we use the K_A coefficient in the Eq. (1), which takes into account the increase in the efficiency of kinetic energy transfer by an accelerated deuterium atom to the target atom (see figure 1):

$$K_A = \frac{(dE/dx)_{electr} + (dE/dx)_{nucl}}{(dE/dx)_{nucl}}, \qquad (2)$$

where $(dE/dx)_{electr}$ is the LEL of the deutron in the target when interacting with electrons (electron losses), $(dE/dx)_{nucl}$ is the LEL of the deutron in the target during elastic scattering (nuclear losses).

Figure 1 shows the results of calculating the neutron yield in the D-D reaction when irradiating a TiD_2 target with deuterium atoms.

The performed studies have shown that when the target is irradiated with fast deuterium atoms, the neutron yield can be significantly higher when irradiated with deuterons, due to the reduction of electronic losses. The TEMP-6 accelerator (300 keV, 150 ns) [3], when generating a pulsed beam of deuterium atoms, can form neutron pulses with an integral neutrons yield per pulse of $\approx 6 \cdot 10^{12}$ neutrons.

REFERENCES

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