Influence of Crystal Lattice Defects and the Threshold Resonance on the Deuteron-Deuteron Reaction Rates at Room Temperature

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Based on the cross section measurements of the deuteron-deuteron reactions preceding in metallic as well as in gaseous targets at the deuteron energies of several keV, it could be shown that both the threshold resonance and the electron screening effect are responsible for an exponential-like enhancement of the reaction yields for lowering projectile energies. Angular distributions and the branching ratio of the $^2H(d,n)^3He$ and $^2H(d,p)^3H$ reactions could be well described assuming a destructive interference among the 0+ threshold resonance and some highly excited resonances in the compound nucleus ^4He. On the other hand, the contribution resulting from the electron screening in metallic environments was estimated by comparing experimental and theoretical reaction yields which are in agreement with experimental data obtained for the gaseous target. A strong correlation of the experimental reaction yields with the number of crystal lattice defects was observed, which could be explained by increasing the effective electron mass in case of a small contamination of the target surface by oxygen and carbon atoms. The latter effect changes the fusion reaction rates extrapolated down to the room temperature by many orders of magnitude and might clarify the strong target material dependence of the heat excess production in the room temperature experiments.