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New integral experiments for a variety of fusion reactor materials with DT neutron source at JAEA/FNS

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In order to validate the nuclear data, we performed integral experiments on tungsten, vanadium-alloy (V-4Cr-4Ti) and copper with the DT neutron source at JAEA/FNS over 20 years ago. The calculated results largely underestimated the measured ones sensitive to low energy neutrons. Background neutrons scattered in the concrete wall of the experimental room may cause these underestimations. In order to reduce the background neutrons and validate the nuclear data adequately, we perform new integral experiments with these materials covered with Li2O blocks which absorb background neutrons effectively. In addition, we also newly perform integral experiments on molybdenum and titanium. We measure the reaction rates of dosimetry reactions with activation foils and the fission rates of U-235 and U-238 with micro fission chambers. We analyze these experiments by using the Monte Carlo code MCNP5-1.40 with the recent nuclear data libraries, ENDF/B-VII.1, JEFF-3.2, JENDL-4.0 and FENDL-3.0. The large underestimations observed in the previous studies are drastically improved in tungsten and vanadium-alloy experiments, and all the calculation results generally show good agreements with the measured ones. Although the underestimation is improved in copper experiment, the calculation results still underestimate the measured ones. It is demonstrated that the underestimation is drastically improved by applying the Cu-63 data in JEFF-3.2 and Cu-65 data in JENDL-4.0 with 10% larger elastic scattering cross section data and 10% smaller capture reaction cross-section data between 100 eV and 0.3 MeV. The calculation results generally underestimate the measured ones with increasing distance from the front surface of the assembly in molybdenum experiment. From the detailed analysis with partly modified nuclear data based on the measured cross section data of Mo, it is found out that the (n,2n) cross section data for all the Mo stable isotopes in JEFF-3.2 are more suitable than those in JENDL-4.0 and the capture reaction cross section data of Mo-92, Mo-94, Mo-95, Mo-96, Mo-97 and Mo-100 in JENDL-4.0 should be decreased. The calculation results with ENDF/B-VII.1 agree with the measured ones the best in titanium experiment, because the (n,2n) and (n,n'_cont) reaction cross section data and resonance parameters are better than those in the other nuclear data libraries.

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