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Measurement of displacement cross section in J-PARC for proton kinematic energy range from 0.4 GeV to 30 GeV

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For damage estimation of structural materials in the accelerator facility, displacement per atom (DPA) is widely employed as an index of the damage calculated based on the displacement cross section obtained with the calculation model. Although the DPA is employed as the standard index of material damage, the experimental data of displacement cross section are scarce for a proton in the energy region above 20 MeV. Among the calculation models, the difference about 8 times exists for tungsten so that experimental data of the displacement cross section is crucial. To obtain the displacement cross section, which can be obtained by the change of resistivity of the sample under irradiated with proton with cryogenic temperature, we have started the experiment in J-PARC to measure the displacement cross section between 0.4 and 3 GeV. As a preliminary result, the displacement cross-section of copper was successfully obtained for 3-GeV proton. The present results showed that the widely utilized Norgertt-Robinson-Torrens (NRT) model overestimates the cross section about 3 times, as suggested by the previous experiment in the lower energy region. It is also found that the calculation with a recently proposed athermal recombination-corrected (arc) model by Nordlund et al. shows remarkably good agreement with the present data.

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