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P4.106 Dynamics evaluation of hydrogen isotope behavior in tungsten simulating damage distribution at operating condition

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Due to the higher melting point and lower sputtering yield, tungsten (W) is considered as the candidate for plasma facing materials (PFMs) in the future fusion reactors. Under working condition, W will be exposed to 14 MeV neutrons produced by D-T fusion reaction, as well as energetic particles such as hydrogen isotope, helium ion. The damages introduced by charge-exchanged particles are concentrated near the surface region, while that induced by 14 MeV neutrons are extended throughout the bulk. For the development of the effective fuel recycling and the safety operation, it is necessary to clarify the hydrogen isotope retention behavior in W with the consideration of damage distribution. In this study, irradiation damage distributions were controlled by 0.8 MeV and 6 MeV Fe ion irradiation with the damage concentration of 0.03-0.3 dpa (displacement per atom). According to calculation using SRIM code, the implantation depth of 0.8 MeV and 6 MeV Fe ions are about 0.5 µm and 1.5 µm, respectively. After the damage introduction by Fe ions, 1.0 keV deuterium ion (D2+) implantation was performed with the flux of 1.0 × 1018 D+ m−2 s−1 and up to the fluence of 1.0 × 1022 D+ m−2. The D retention behavior was evaluated by thermal desorption spectroscopy (TDS) at up to 1173 K with the heating rate of 0.5 K s−1. The experimental results showed that the total D retentions in the samples were decreased by the increasing the damage concentration introduced near the surface region by 0.8 MeV Fe ions. Retention of D trapped by vacancy clusters and voids, which are the trapping sites with higher trapping energies, was reduced, suggesting that the recombination of D atom into D2 on the W surface was enhanced due to D accumulation near the surface.

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