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Hydrogen Isotope Retention in Tungsten Surface-modified by Heavy Ion Irradiation, Helium bubbles and Tungsten Deposition

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Tungsten is a candidate material for plasma facing components of DEMO as well as divertor plates of ITER, because it has favorable properties such as a very low solubility for hydrogen isotopes. However, surface condition of the plasma facing material is certainly changed by plasma-wall interaction (PWI). Such a surface modification could affect a property of H isotope retention which is a key concern for safety hazards as well as particle control. It is important to investigate relation between change in microstructure due to PWI and H isotope retention but such studies are few. In this paper, two kinds of experiments have been carried out to study H isotope retention in surface-modified W taking microstructure of the surface modification into account using a compact PWI simulator APSEDAS. One is damage level dependence for W irradiated by 2.4 MeV Cuˆ2+ ions as surrogate of neutron irradiation. The other is D fluence dependence for W with a He bubble layer, W with a W deposited layer and pure W.
Hydrogen isotope retention in W irradiated by 2.4 MeV Cuˆ2+ ions as surrogate of neutron irradiation increased significantly with the damage level up to 0.4 dpa and then saturated. A new desorption peak appeared at ˜840 K in a thermal desorption spectra due to the heavy ion irradiation, which is attributed to nano-voids and vacancy clusters. On the other hand, the D retention in W with He bubbles became saturated for fluence over 1 x 10ˆ25 D mˆ-2, although retention in pure W increased with square-root dependence of the fluence. Retention in W with a W deposited layer with the thickness of ˜30 nm was ˜5 times lower than that of pure W. The surface modifications of He bubbles and W deposition seem to play a role of diffusion barrier for the mobile D atoms.

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