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Hydrogen isotope mixed plasma driven permeation for W and its neutron irradiation and He seeing effects

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For the establishment of fusion reactor, it is essential to elucidate the physical parameters related to hydrogen isotope transport through plasma-facing materials under the consideration of hydrogen isotopes (H/D/T). To accurately predict hydrogen isotope behavior, damage by neutrons and energetic charged particles, combined with He ash effects, should be extensively studied at fusion-relevant higher temperatures. In our previous study, D retention has increased by introduction of irradiation damage in W, but D permeation was reduced. However, the contamination of the plasma with less than 1% He clearly reduced hydrogen isotope retention by a factor of 10 below 813 K. In addition, H and D permeation behavior in W showed that the permeation flux was also controlled by the square root of mass. In this study, the plasma driven permeation (PDP) with H/D mixed plasma (H:D=50:50) were performed using newly developed PDP device in the radiation controlled area at Shizuoka University, and their isotope effect was evaluated. The permeation flux and their H/D ratio was evaluated for undamaged W, 1 spa Fe ion damaged W and 0.3 dpa neutron damaged W.
For, undamaged W, large hydrogen isotope effect was observed at lower temperatures (~ 700 K),□H:D ≅ 2:1). As the temperature was increased, the H and D permeation fluxes was almost unity. The H and D permeation fluxes was reduced by He seeding, due to the formation of He bubbles at the surface of upstream side.

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