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Plasma driven permeation of hydrogen isotope for W

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Tungsten (W) is one of candidate plasma facing materials for future fusion reactors due to its favorable properties such as high melting point, low physical sputtering yield and low solubility for hydrogen (H) isotopes. During the operation of fusion reactor, W will be exposed to high flux deuterium (D), tritium (T) and helium (He) particles in addition to 14 MeV neutron under elevated temperature. The energetic T ions will impinge on W surface and migrate toward the coolant, leading to the loss of T and contamination of coolant. Therefore, it is crucial to evaluate T permeation through W from the view of fusion reactor safety and T selfsufficiency. In the present work, the influence of He or irradiation defects on the plasma driven permeation behavior in tungsten material are studied. The D2/He mixture plasma driven experiment (PDP) is performed to evaluate the He effect on the D plasma driven permeation behavior. The He emission is detected in the D2/He mixture plasma by a spectrometer. The reduction in steady state D permeation flux is observed as the presence of He ions in plasma. To understand the effect of irradiation defects on the D plasma driven permeation behavior, PDP experiment is carried out with the iron ions (Fe2+) irradiated W with the maximum damage level of 1 displacement per atom (dpa). The results show that the steady sate D permeation flux for damaged W sample is lower than that for undamaged one. The lower permeation flux at back surface in the case of D2/He PDP or PDP for damaged W indicates a lower D in solution near the front surface.
In addition, recently, PDP experiment by H/D mixed plasma has started. In this presentation, recent progress of the H/D PDP experiment will be explained.

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