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Deuterium trapping and defect production in recrystallized tungsten exposed to high-fluence plasmas

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Plasma-surface interaction (PSI) is one of the key factors determining the availability of commercial fusion. Response of materials exposed to PSI-relevant plasma is usually investigated using linear plasma devices. However, experiments at high fluences are very limited due to the extended plasma exposure duration. This work is dedicated to evaluate hydrogen transportation in tungsten at the condition of high fluences.
In this work, deuterium plasma exposures with a highest fluence up to 1E28 m-2 in recrystallized tungsten samples have been achieved at STEP at Beihang University and Magnum-PSI at DIFFER. Deuterium desorption was measured using thermal desorption spectroscopy and modeled by the rate theory code. Therefore, deuterium and defect depth profile beyond 7 micron could be estimated, and the function of defect generation could be fitted within the investigated fluences. Besides, the effect of flux (1E22 m-2s-1 versus 1E24 m-2s-1) on deuterium retention is investigated.
This work provide verification of the hydrogen transport theory and parameters and a simplified defect production function within the investigated conditions. The output of the work could serve as a reference for estimating tritium trapping in plasma-facing materials in future devices.

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