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P3.102 Effect of initial microstructure on the retention and desorption of deuterium and helium from W exposed to plasma

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In the process of burning fusion plasmas, plasma-facing materials such as tungsten-based materials (W) will be exposed to energetic particles of hydrogen isotopes and helium (He), high heat flux, and neutrons. In this regard, a study of accumulation of hydrogen isotopes and He in W under normal operation conditions and transit events appears necessary for assessment of safety of fusion reactor due to the radioactivity of tritium and material performance and for the plasma fuel balance. In the present work, we focus on understanding of an effect of initial microstructure of W on the fuel and He retention. Polycrystalline bulk W (PCW) and dense nano-crystalline W coating produced by Combined Magnetron Sputtering and Ion Implantation (CMSII) technology have been exposed to deuterium (D) and He plasmas at different specimen temperatures ranged from 320 to 1250 K up to fluences of 10^26 at.m-2. We found that both the D and He retentions are higher in nano-crystalline W compared to PCW. The D retention decreases but the He retention slightly increases in both PCW and CMSII-W coating with increasing the temperature from 500 K to 1250 K. The seeding of 5-15% of He into the D plasma reduces the D retention in both PCW and CMSII-W coating but this effect is more pronounced for PCW. The nanostructured W 'fuzz' formation due to He plasma exposure at temperatures of 1000-1250 K results in the increase of the He retention in both PCW and CMSII-W coating but the threshold of the W fuzz formation is shifted to higher temperatures in the case of nanostructured coating. The additional low-temperature desorption stages below the irradiation temperature were found in W materials after fuzz formation. The physics of D and He retention and desorption and ways of their reduction are discussed.

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