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The use of ion beam irradiation to simulate neutron-induced displacement damage in tungsten

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Tungsten (W) is considered as a promising plasma-facing material for future fusion reactors. W components will be subjected to an intense flux of 14 MeV neutrons. This will result in creation of radiation defects, production of H, He and transmutation elements. Radiation defects can trap the tritium fuel, posing safety and economic concerns.
MeV heavy ion irradiation is widely used for simulating the displacement damage created by 14 MeV neutrons because it induces dense collision cascades and does not alter the material composition. This contribution will give an overview of the studies performed at IPP Garching over the last decade. It will focus on the influence of irradiation temperature and damage dose in W. The irradiated samples are exposed to a low-flux of low-energy deuterium (D) ions extracted from an ECR plasma at low material temperature (370 K). This allows to decorate the irradiation-induced defects with D without introducing additional damage and deduce the total trap densities. Trapped D concentration profiles are measured using D(3He, p)4He nuclear reaction analysis. The D binding states in the defects are analysed using thermal desorption spectroscopy (TDS). This is accompanied by reaction-diffusion simulations to derive D binding energies with the defects.

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