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A Study of Lattice Defects in Tungsten using a slow Positron Beam

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Predicting helium retention in tungsten is of relevance for future nuclear fusion reactors as it influences tritium uptake and transport, two processes which are critical factors in achieving tritium self-sufficiency. While the macroscopic effects of helium agglomeration in tungsten are known it is still an open topic of discussion what the underlying processes on a microscopic scale are. Our goal is to contribute to this discussion by providing experimental results for a "simple"system, i.e tungsten mono-crystals that only contain single vacancy defects.

We therefore compare samples where defects have been induced by either MeV electron bombardment or thermal quenching. While the initial and post damaging state of the samples is also monitored by different types of microscopy, Doppler-broadening spectroscopy is used as the main tool since it shows the highest sensitivity to vacancy-like defects. The positron-annihilation measurements shown have all been performed on a tungsten-moderated, Na-22-based mono-energetic slow positron beam which has been modified to deliver acceleration voltages of up to 40 kV.

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