THERMAL DESORPTION OF HELIUM FROM TUNGSTEN FOILS

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Tungsten is one material considered for the first wall of an inertial fusion energy (IFE) reactor. Energetic helium ions produced inside the reactor will likely have damaging effects on the first wall. Helium concentrations implanted in the wall may lead to helium bubble formation and eventual surface blistering. First wall thermal evolution models of the IFE indicate a cyclic temperature behavior between ~1123 K and ~2673 K. Previous experiments revealed that stepwise implantation of helium at 1123 K and heating to 2273 K in many cycles to reach the same total dose reduced helium retention. A thermal desorption spectroscopy (TDS) study on helium-implanted tungsten foils was conducted to gain understanding about the helium trapping/detrapping characteristics and their dependence on parameters such as implant dose and temperature.

Single crystal and polycrystalline tungsten samples were implanted with helium under various conditions using a Van de Graaff accelerator. Helium doses ranged from 10^{16} to 10^{21} He/m^2 and implant temperatures ranged from room temperature to 1123 K. The thermal desorption chamber included a water-cooled sample holder that allowed for resistive heating from room temperature up to 2673 K. A quadrupole mass spectrometer was used to detect desorbed helium as the sample temperature was ramped at 1 – 5 K/s. Each desorption experiment was preceded by baking the chamber at 373 K and pumping for at least 12 hours to achieve a base pressure around 1 – 5 x 10^{-8} Torr. TDS data indicated that the desorption characteristics depended on implantation conditions and whether the sample was single crystal or polycrystalline.