Tungsten microstructural changes induced by ISTTOK plasma discharges

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Hydrogen retention in bulk tungsten is a critical issue in fusion devices due to tritium inventory concerns and microstructural modifications induced in the exposed materials. In a previous work, hydrogen retention and severe microstructural changes (as abnormal grain grow and intragranular hydrogen bubbles resulting from a coalescent process) were identified in tungsten Langmuir probes exposed at the ISTTOK edge plasma. The aim of the present work is to narrow down the plasma parameter window and the irradiation geometry inducing these types of microstructural changes.

Tungsten wires and plates were exposed to ISTTOK regular shots ($T_e \sim T_i$ = 20–40 eV; E_{dep} ~15J/disch.) and Taylor discharges ($T_e \sim T_i$ = 10 eV; E_{dep} ~1KJ/disch.) in a new irradiation campaign. Hydrogen retention measurements were carried out by Elastic Recoil Detection Analysis. Structural changes on the tungsten cross-section and surface were evaluated by Scanning Electron Microscopy and Transmission Electron Microscopy.

Regular operation discharges cause higher hydrogen content and important structural modifications in the irradiated regions. In contrast, no visible modifications are observed after the Taylor discharge experiments.