Tungsten microstructural changes induced by ISTTOK plasma discharges

R. Mateus1*, P.A. Carvalho1,2, J.B. Correia3, D. Nunes1, R.B. Gomes1, P. Duarte1,
H. Fernandes1, C. Silva1, E. Alves4

1Associação Euratom/IST, Instituto de Plasmas e Fusão Nuclear – Laboratório Associado,
Instituto Superior Técnico, Av. Rovisco Pais, 1049-001 Lisboa, Portugal
2ICEMS, Departamento de Engenharia de Materiais, Instituto Superior Técnico,
Av. Rovisco Pais, 1049-001 Lisboa, Portugal
3LNEG, Departamento de Engenharia de Materiais e Tecnologias de Produção,
Estrada do Paço do Lumiar, 1649-038 Lisboa, Portugal
4ITN, Instituto Tecnológico e Nuclear, Estrada Nacional 10, 2686-953 Sacavém, Portugal

Corresponding author: rmateus@ipfn.ist.utl.pt

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 growth 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 (Te~Ti = 20–40 eV; Edep ~15J/disch.) and Taylor discharges (Te~Ti = 10 eV; Edep ~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.