# The role of grain boundaries on light species behavior in nanostructured tungsten

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## Abstract

A great challenge in the design of future nuclear power plants is to develop materials capable to resist the hrash conditions taken place in a nuclear fusion reactor. Nowadays, tungsten (W) is one of the most important candidates proposed to form the first wall in a nuclear fusion reactor, because of its low sputtering yield, low-activation, high melting point, high thermal conductivity and low thermal expansion [1]. Nevertheless, this material has some limitations which must be overcome in order to satisfy the specifications, among them, the light species retention. Light species (mainly H, D, T and He), which are present in the plasma in magnetic confinement fusion and which result from the explosion in inertial confinement fusion, are implanted in PFM, notably degrading its properties [2-4].

In this work we focus on the study the influence of sample microstructure and of irradiation conditions in nanostructured tungsten (NW) coatings as compared to commercial coarse grained tungsten (CGW) samples in the hydrogen behaviour. To this aim, NW and CGW samples were implanted with (i) H at an energy of 170 keV, (ii) sequentially implanted with C (665 keV) and H (170 keV) and co-implanted with C (665 keV) and H (170 keV). Implantations were carried out at a fluence of $5x10^{16}$ $cm^{-2}$ and at two different temperatures RT and 400ºC. Scanning electron microscopy (SEM) images show that, after irradiation, nanostructured samples preserve its nanometric features and that there is no sign of blistering in any of the studied samples. X-ray diffraction (XRD) data indicate that all the samples keep being mono-phase (α-W phase) after irradiation and that no secondary phases appear after the implantation of H and/or C. Resonant nuclear reaction analysis (RNRA) data reveal that H concentration for samples implanted only with H is higher for NW than for CGW, and it becomes comparable for both kind of samples after sequential implantation with C and H. Increasing the temperature during irradiation up to 400ºC leads H to completely out diffuse in NW as well as in CGW samples. The role of microstructure and radiation-induced damage on light species behaviour is discussed.

## References

[1] H. Bolt, V. Batrabash, W. Krauss, J. Linke, R. Neu, S. Suzuki, N. Yoshida, ASDEX Upgrade team, Journal of Nuclear Materials (2005) 329-333, 66

[2] C. Garcia-Rosales, P. Franzen, H. Plank, J. Roth and E. Gauthier, Journal of Nuclear Materials (1996) 233-237, 803

[3] P. Franzen, C. Garcia-Rosales, H. Plank and V. Kh. Alimov, Journal of Nuclear Materials (1997) 241-243, 1083

[4] O. V. Ogorodnikova, J. Roth, M. Mayer, Journal of Nuclear Materials (2003) 313-316, 469