Hydrogen Distribution in Tungsten

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In future magnetic confinement fusion devices the divertor will be mainly made from tungsten. Therefore its hydrogen uptake and retention properties are of key importance for controlling the in-vessel tritium inventory and the particle density during operation. Since tungsten does not form hydrides, the dominant hydrogen retention mechanism is trapping at natural or particle bombardment induced defects. It is the aim of our current research to elucidate how hydrogen binds at different defect types in tungsten. To this end the knowledge of how different defects are distributed over depth in our tungsten samples is of key importance.

As shown in the figures, tungsten irradiation with deuterium plasma or ions might cause some blistering on the surface (Fig. 1) and crack growing (Fig. 2). It is essential to know the microscopic distribution of hydrogen here in order to understand the dynamics of these effects. The 3D hydrogen microscopy setup at the microprobe SNAKE [1,2] offers the unique spatial resolution and sensitivity to analyze these defects, where other methods fail.

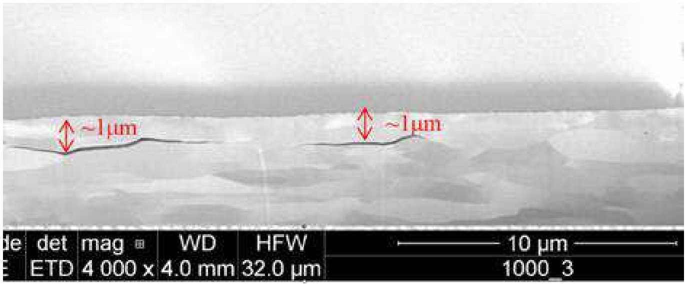

Fig. 1: SEM picture of a tungsten surface after 38 eV D plasma irradiation at 470 K. We can clearly see some crack around 1 μm under the surface.

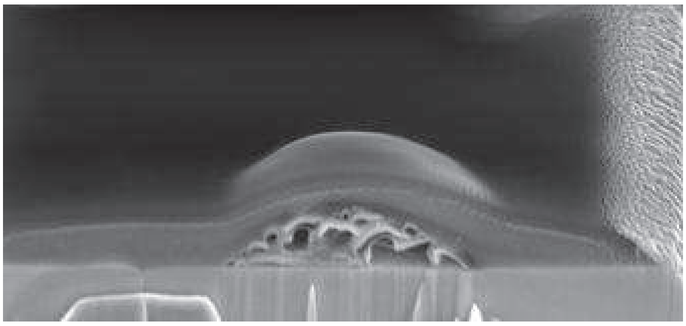

Fig. 2: 7 μm diameter blister on the W surface, which appeared after D ions irradiation at RT.

We intend to correlate the hydrogen maps from SNAKE with NRA results and SEM pictures. The results should allow us to improve our hydrogen transport modelling calculations and let us understand which defects are filled with hydrogen and which are not for certain implantation conditions.

References

[1] P. Reichart *et al.*, Science **306** (2004) 1537
[2] P. Reichart *et al.*, Nucl. Instrum. Methods B **219** (2004) 980