

SÉMINAIRE**Mardi 11 juin 2013, 14h**

C.S.N.S.M. - Bât. 108 - Salle de réunion

**Impact of He and Cr on defect accumulation in ion irradiated
high purity Fe(Cr) alloys****Robin Schäublin***(Paul Scherrer Institute, Suisse)***Abstract:**

The effect of He on the primary damage induced by irradiation in ultra high purity (UHP) Fe and Fe(Cr) alloys is investigated using a unique facility, JANNuS Orsay. Materials were irradiated in JANNuS at room temperature in a transmission electron microscope (TEM) coupled to two ion accelerators, providing simultaneously 500 keV Fe⁺ and 10 keV He⁺ ions. Single Fe ions and dual Fe and He ions beam experiments were performed up to a dose of 1 dpa and to a He content of up to 1000 appm. Defects appear in the form of nanometric black dots with sizes between 1 and 5 nm. Defocused images reveal a dense population of sub-nanometric cavities after both single and dual beam irradiations.

Electron transparent sample for TEM inherently presents a different situation to the irradiation induced defects relative to a bulk specimen because of the presence of the two free surfaces. Their impact on defects is assessed using molecular dynamics simulations using a 3 and 5 nm $\frac{1}{2} a_0 \langle 111 \rangle$ dislocation loop as a probe. This study indicates that the impact is large, with image forces due to the free surfaces sufficient to drive the loop out of the foil when it is less than 5 nm deep. Besides, the problem of the identification of the Burgers vector using classical methods was revisited. A new method based on statistics for the Burgers vector analysis of small dislocation loops in high densities was successfully developed, allowing taking into account selective bias of the free surfaces on the different defect population due to defects' crystallographic orientation.

In Fe(Cr) alloys the number densities of visible black dot defects still resolved in TEM are significantly higher after single than after dual beam irradiation. In UHP Fe, conversely, the presence of He strongly increases the defect number density, which is also observed in irradiated bulk specimens [1]. The presence of He changes from a $a_0 \langle 100 \rangle$ dominated defect population to a $\frac{1}{2} a_0 \langle 111 \rangle$ dominated one in all materials, and the more so in UHP Fe. It appears that Cr increases the amount of visible defects relative to UHP Fe. The dependence with increasing Cr content is however weak, showing only a slight decrease in the number densities. The decrease in the density of visible $a_0 \langle 100 \rangle$ loops and increase of the visible $\frac{1}{2} a_0 \langle 111 \rangle$ ones in all materials when He is present supports the idea that $a_0 \langle 100 \rangle$ loops are formed by the direct interaction of mobile $\frac{1}{2} a_0 \langle 111 \rangle$ loops, as the latter would be immobilized by He already at sub-microscopic sizes, as shown by MD [2].

[1] A. Prokhodtseva, B. Décamps, R. Schäublin, *Journal of Nuclear Materials* (2013), <http://dx.doi.org/10.1016/j.jnucmat.2013.04.032>.

[2] G. Lucas, R. Schäublin, *Journal of Physics: Condensed Matter*, **20**, 415206 (2008).

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Rafraîchissements : 13 h 45.

Renseignements CSNSM :

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