Contribution ID: **149** Type: **Contributed**

Erosion and tungsten surface enrichment of Eurofer-97 steel exposed to a deuterium plasma in the GyM linear device

Thursday 21 June 2018 10:10 (20 minutes)

In future nuclear fusion reactors, the erosion by hydrogenic charge-exchange neutrals will strictly affect the lifetime of the recessed elements of the first wall [1]. Among the possible candidates for these components, reduced activation ferritic martensitic (RAFM) steels, such as Eurofer-97, containing small amounts of high-Z elements like tungsten (W), are a valuable economical and technological option.
Due to the higher sputtering yield for hydrogenic particles of iron (Fe) compared to that of W, it was demonstrated [1,2] that Fe of RAFM steels exposed to low energy deuterium (D) ions erodes faster, leading to a W-rich surface. Moreover, it turns out [1] that the erosion dynamics of RAFM steels strictly depends on their temperature (T). Thermal effects like inter-diffusion of Fe and W and also the W segregation toward the surface [3] could indeed respectively enhance and counteract the erosion. However, a comprehensive study of the impact of temperature on W enrichment of RAFM steels is still missing. For a controlled investigation of W enrichment as a function of RAFM steels temperature, Eurofer-97 samples were exposed to the D plasma of the linear machine GyM [3], at three different temperatures: 600 K, 800 K and 1000 K. For each T, five ion fluences, in the range of 4.5×1024 ÷ 2.3×1025 ions m-2, were considered, keeping the ion energy nearly constant to 200 eV by applying a proper negative bias voltage to the samples holder.
The erosion rate was evaluated from profilometry and weight loss. The W enrichment was estimated using Rutherford backscattering and low-energy ion scattering spectroscopies. Possible Eurofer-97 samples compositional changes were investigated after the exposures with depth-profiling X-Ray photoelectron spectroscopy. Considering the highest fluence, preliminary results show that the erosion of Eurofer-97 at 1000 K is ˜50% higher than that at 600 K due to inter-diffusion of Fe and W.

[1] J. Roth, et al., J. Nucl. Mater. 1-6 (2014) 454
[2] P. Ström, et al., Nucl. Instrum. Meth. B 371 (2016) 355-359
[3] R. Caniello, et al., Nuclear Materials and Energy 10 (2017) 9-1

2014-2018 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

Author: Dr GHEZZI, Francesco (Istituto di Fisica del Plasma-CNR)

Co-authors: Dr UCCELLO, Andrea (Istituto di Fisica del Plasma-CNR); Dr IVA, Bogdanović Radović (Institut Ruđer Bošković); Mr DELL'ERA, Fabio (Istituto di Fisica del Plasma); Mrs MELLERA, Vittoria (Istituto di Fisica del Plasma-CNR); Mr PEDRONI, Matteo (Istituto di Fisica del Plasma); Dr RICCI, Daria (Istituto di Fisica del Plasma)

Presenter: Dr GHEZZI, Francesco (Istituto di Fisica del Plasma-CNR)

Session Classification: Vacuum in Accelerators

Track Classification: Vacuum in Accelerators