Contribution ID: **248** Type: **Poster**

The influence of displacement damage and helium on deuterium transport and retention in tungsten

Tuesday, 23 October 2018 08:30 (20 minutes)

Among many other favorable properties of tungsten its low intrinsic fuel retention makes it a promising candidate as plasma facing material. However, during operation defects in the tungsten lattice will evolve that will trap hydrogen isotopes. While for present day devices this increased retention is only limited to the near surface it will take place throughout the whole bulk in future nuclear devices as a consequence of the neutron irradiation. There is not yet a microscopic understanding that would allow to describe the processes that will prevail in a reactor environment quantitatively, where damage creation and hydrogen retention will mutually influence each other. Present day predictions are only based on extrapolation of data collected from non-nuclear machines. Hence, the influence of hydrogen on defect production, the influence of defects on hydrogen isotopes transport as well the influence of the presence of helium (directly implanted close to the material surface from the plasma as well as produced throughout the bulk by tritium decay and transmutation) is not considered in these extrapolations.
Implantation of different ion species with energies in the MeV range can be used to simulate the displacement damage neutrons will cause. Contrary to neutron irradiation, ion beam irradiation is fast and does not activate the samples. Likewise, the influence of He on transport and retention can be studied by implanting He with MeV-energy deep into the material. In this way surface effects can be separated from bulk effects. These kind of experiments allow dedicated parameter studies under well controlled conditions. In this contribution such benchmark experiments on transport and retention of deuterium in displacement damaged and helium containing tungsten are presented that allow to test and extend present day understanding on a quantitative level. The dependence of deuterium retention on the damage level, the influence of damage rate as well as the influence of the specific ion used to create the displacement damage will be shown. Results from hydrogen isotope exchange experiments are presented that reveal the dynamics of hydrogen transport which is a chain of trapping and detrapping processes. Rate equation modelling without free parameters is used to describe the observed uptake during plasma exposure as well as the release during annealing.

Country or International Organization

Germany

Paper Number

FIP/P1-18

Primary author: Dr SCHWARZ-SELINGER, Thomas (Max-Planck-Institut für Plasmaphysik)

Co-authors: Dr MANHARD, Armin (Max-Planck-Insititut für Plasmaphysik); Dr BAUER, Johannes (Max--Planck-Institutfür Plasmaphysik); Dr SCHMID, Klaus (Max-Planck-Institut für Plasmaphysik); Dr MARKELJ, Sabina (Josef Stefan Institute)

Presenter: Dr SCHWARZ-SELINGER, Thomas (Max-Planck-Institut für Plasmaphysik)

Session Classification: P1 Posters

Track Classification: FIP - Fusion Engineering, Integration and Power Plant Design