Contribution ID: **28** Type: **not specified**

Experimental validation of H permeability models for Be, W and RAFM steels

Tuesday, 24 November 2020 15:20 (20 minutes)

Accurate models for plasma-driven permeation play an important role in predicting the fuel retention and tritium recovery from plasma-facing components of future fusion devices. Only with an in-depth understanding developed from such models can we plan for safe and successful operational campaigns. In order to develop new models, capable of describing newly observed physical and chemical processes and/or non-equilibrium conditions, as well as validate the existing ones, a large database of experimental results is required.

With a focus on ITER, we have experimentally investigated D retention and release from Be co-deposits and bulk Be samples. Bulk samples were exposed to D plasma and Be/D co-deposits were deposited at different experimental conditions, varying D neutral pressure, sample temperature, and energy of the impinging particles. With the use of a standard rate-equation diffusion/trapping model, we were able to recognize four Arrhenius-type traps and study the influence of implantation/deposition conditions on trap densities and D retention. In addition to the four traps, we observed the appearance of a sharp low-temperature release peak in the TDS spectra, but only under certain experimental conditions. The simple diffusion/trapping model was unable to reproduce such a peak nor the release behavior under ramp-and-hold types of desorption. The model was modified by incorporating the physics of decomposition of beryllium deuteride precipitates, which allowed us to accurately reproduce our experimental results. However, the modified model showed possible uncertainties of the widely used surface recombination coefficient, therefore additional work is needed to verify the new model and determine the validity of the newly determined recombination coefficient.

With a focus on burning plasma operations, our work on W includes studying the non-equilibrium conditions that exist during D plasma implantation into bulk W. Laser-induced breakdown spectroscopy (LIBS) allows us to measure D concentrations in the near-surface region during plasma exposure. It has been shown that a super-saturated layer exists in the near sub-surface region, exhibiting extremely high concentrations of hydrogen isotopes. The standard diffusion/trapping model is not capable of reproducing such non-equilibrium phenomena, therefore, modifications to the model are needed. In addition, calibrated high-resolution SIMS will provide ex-situ measurements of D depth profiles resulting from different plasma exposure conditions, which will be used to validate the modified model. Retention measurements have also been made in RAFM steels, however modelling the release from these materials is complicated and needs some further attention.

This talk will focus on our recent and future attempts to develop better and more accurate models capable of describing and predicting hydrogen isotope interaction with fusion relevant materials. Our plans for future experimental work producing results needed for validation of such upgraded models will be presented and discussed.

Primary author: ZALOZNIK, Anze (UCSD)

Co-author: THE PISCES TEAM (UCSD)

Presenters: ZALOZNIK, Anze (UCSD); THE PISCES TEAM (UCSD)

Session Classification: Plasma-driven perm. I