Absorption and Desorption Characteristics of Hydrogen Isotopes Implanted into Stainless Steel by Glow Discharge and Baking

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Hydrogen isotope retention and its removal in/from a plasma-facing wall and structural materials have been recognized as key issues for fusion reactor from the viewpoints of safety operation and preserve environment. Baking and/or a glow discharge (GD) are possible effective methods to remove hydrogen isotopes from materials. To investigate the absorption and desorption characteristics of hydrogen isotopes in structural materials, a glow discharge apparatus with twin chambers (Glow-1, 2) made with stainless steel was provided.

The Glow-2 chamber was filled with hydrogen (H_2) or deuterium (D_2) gas and a GD (130 Pa, 20 mA) was applied without pumping for 30 minutes. The H_2 or D_2 pressure went down during the GD and total amount of H or D atoms absorbed into the chamber wall were estimated from the decrease in the pressure. Typical number was $7.9 \pm 0.1 \times 10^{18}$ atoms for H, and $7.2 \pm 0.6 \times 10^{18}$ atoms for D. The Glow-2 chamber was baked at around 180 $^{\circ}$C with pumping speed of 28 L/s for 3 hours and the number of desorbed atoms were estimated by integrating the pressure during the baking. Ratio of desorbed/absorbed atoms is 16 – 30 % depending on interval between the GD and baking, which suggests that the absorbed H/D is desorbed even at the room temperature.

A stainless steel sample (15mmsq, SUS316) was exposed to the D_2 GD for 30 minutes in the Glow-2 chamber, and moved to the Glow-1 chamber without exposing to the air. In the Glow-1 chamber, the sample was heated by the controlled infrared (IR) heating equipment. A constant IR power flux was applied to the sample and the released gases were analyzed by a calibrated mass spectrometer. Most of retained deuterium was released in the low temperature (< 150 $^{\circ}$C). In these experiments, we could not observe any water release from the sample. Now we are comparing these results with a diffusion model calculation, and both agrees qualitatively. We need to investigate the difference of the release characteristics by the difference of the gas trapping form.