27th IEEE Symposium on Fusion Engineering



Contribution ID: 369

Type: Poster

## Hydrogen isotopes plasma-driven permeation through sputter-deposited tungsten coated F82H

Wednesday 7 June 2017 13:40 (2 hours)

Tungsten (W) has been proposed as the candidate plasma-facing material for the divertor of International Thermonuclear Experimental Reactor (ITER) because of its beneficial properties such as high melting point, high thermal conductivity and low sputtering yield [1]. For a DEMO reactor, surface coatings made of W are necessary to protect the plasma-facing wall made of reduced activation ferritic steels (RAFS) such as F82H (Fe-8Cr-2W) [2]. The characterization of hydrogen isotopes transport through W coated RAFS under plasma exposure is of crucial importance to evaluate major reactor design issues including tritium retention, breeding feasibility and first wall particle recycling.

In this study, hydrogen isotopes plasma-driven permeation (PDP) through sputter-deposited W (SP-W) coated F82H has been investigated in the temperature range of 300 - 550 °C using a laboratory-scale linear plasma device: VEHICLE-1 [3]. The plasma density is of the order of 10<sup>10</sup> cm<sup>-3</sup> and the net implantation flux is estimated to be  $1 \times 10^{16}$  atom/cm<sup>2</sup>/s. The incident ion energy is controlled by biasing the sample. A bias of 100 V has been used for PDP in the present work. The density of SP-W coatings is evaluated to be  $19.2 \text{ g/cm}^3$ , 99.5% of bulk W. The thicknesses of W coatings are 0.5 - 4 µm, while the thicknesses of F82H membranes are 0.5 - 2 mm. Bare F82H membranes with various thicknesses are used for comparison.

It has been found that hydrogen isotopes PDP fluxes through SP-W coated F82H are significantly higher than that through bare F82H in the investigated temperature range of 300 - 550 °C. Notice, however, that the PDP flux decreases with increasing temperature. Deuterium retention analyses are performed by thermal desorption spectroscopy (TDS) after steady-state deuterium PDP experiments. The amount of retained deuterium in SP-W coated F82H is a factor of 3 higher than that of bare F82H in the lower temperature range of 320-420 °C and the differences become smaller with increasing temperature. Characterization analyses indicate that enhanced PDP fluxes and high deuterium retention are related to the microstructure of SP-W coatings and the surface recombination characteristics. Nevertheless, further investigations are still underway to address these issues.

[1] R. Pitts, S. Carpentier, F. Escourbiac, et al., J. Nucl. Mater. 438 (2013) S48-S56.

[2] T. Otsuka, T. Tanabe, K. Tokunaga, J. Nucl. Mater. 438 (2013) S1048-S1051.

[3] Y. Hirooka, H. Ohgaki, Y. Ohtsuka, et al., J. Nucl. Mater. 337-339 (2005) 585-589.

## Eligible for student paper award?

Yes

Author: Dr XU, Yue (The Graduate University for Advanced Studies)

**Co-authors:** Prof. HIROOKA, Yoshihiko (National Institute for Fusion Science); Dr ASHIKAWA, Naoko (National Institute for Fusion Science)

Presenter: Dr XU, Yue (The Graduate University for Advanced Studies)

Session Classification: W.POS: Poster Session W

Track Classification: Tritium extraction and control