Contribution ID: **747** Type: **not specified**

P2.176 Deuterium permeation behavior through reduced activation ferritic steel F82H under DEMO reactor blanket condition

Tuesday, 18 September 2018 11:00 (2 hours)

Tritium permeation through structure materials in fusion blanket systems is a critical issue from the perspectives of fuel loss and radiological hazard. In the previous studies, detailed hydrogen isotope permeation behaviors in reduced activation ferritic/martensitic (RAFM) steels have been investigated; however, it is supposed that the surface of the RAFM steel will be oxidized under an actual DEMO reactor condition at a tritium recovery system, and then the permeation behavior will be changed. In this study, deuterium permeation through the RAFM steels heat-treated under simulated environment conditions has been investigated for more precise prediction of tritium loss at DEMO reactor blankets.
RAFM steel F82H substrates were heat-treated in helium gas flow containing 1 vol% hydrogen for 100 h at 300, 400 and 500 °C to simulate a DEMO reactor blanket condition. After surface observation and analysis for the heat-treated samples, gas-driven deuterium permeation measurements were performed. Deuterium permeation flux through the sample was detected by a quadrupole mass spectrometer with the driving pressure of 10.0–80.0 kPa in the temperature range of 250–550 °C.
An iron oxide layer was formed on the F82H surface after the heat treatment. From the results of grazing incidence X-ray diffraction analysis, the major composition of the surface oxidation layer was Fe2O3. The oxide layers became thicker as the heat-treatment temperature increased. The thickness of the oxide layers of the samples heat-treated at 300, 400 and 500 °C was approximately 50 nm, 130 nm and 5 μm, respectively. In the results of permeation tests, the iron oxide layers of all the samples decreased the deuterium permeation down to only 25%, suggesting that the structure of the iron oxide layers were not tight; therefore, the layers naturally formed under the DEMO blanket condition will not be efficient as tritium permeation barriers.

Presenter: KIMURA, Keisuke (Graduate School of Integrated Science and Technology Shizuoka University)

Session Classification: P2