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P4.110 Hydrogen and deuterium behavior on gas driven permeation through tungsten deposition layer on nickel plate

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Understanding of hydrogen isotope behaviors in plasma-facing wall is important from viewpoints of fuel control and tritium safety. Tungsten (W) is a candidate material of plasma-facing components. Although a sputtering rate of W is low, a certain amount of W deposition layer would be formed on the plasma-facing wall during a long time operation of a fusion reactor. However, hydrogen isotope behavior in W deposition layer has not been sufficiently investigated to date. In our previous work, hydrogen gas driven permeation through W deposition layer formed on nickel (Ni) plate was investigated and it was found that hydrogen permeation rate was larger than that in W bulk.

In this work, H2/Ar or D2/Ar gas at atmospheric pressure was supplied to one side of W deposition layer with Ni plate and the behaviors of hydrogen and deuterium released to another side were observed by a quadrupole mass spectrometer (QMS). The samples of W deposition layer were formed on circular plates of Ni by hydrogen RF plasma sputtering. The thickness of Ni plate was 20 micro meter and that of W deposition layer was 0.7 micro meter. The experimental temperatures were 180 – 500oC. The permeation curves by QMS were analyzed by TMAP code.

It was found that the permeation rate of deuterium was smaller than that of hydrogen but diffusivity of deuterium was not different from that of hydrogen. This suggests that deuterium solubility was smaller than hydrogen solubility. When deuterium gas was supplied to the sample after hydrogen permeation experiment was finished, not only deuterium but also hydrogen were quickly released. This hydrogen was considered to be released by an isotope exchange reaction between deuterium penetrating and hydrogen retained in the sample. These results give useful information for development of fuel recycling model in plasma-facing surfaces.

Presenter: MORI, Daisuke (Department of Advanced Energy Engineering Science Kyushu University)

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