Possibility of metal coatings on F82H as the tritium permeation reduction barrier

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F82H, reduced activation ferritic / martensitic steel, is a candidate structural material for a nuclear fusion reactor. According to the previous report by the authors, it is essential to reduce tritium permeation through the F82H structure components at least less than 1/10 -1/100 in a viewpoint of safety and tritium accountancy [1]. Therefore, authors have developed tritium permeation reduction methods using oxide coatings extensively. In the previous study, it was found that some oxide coatings on the metals caused cracks in the coatings due to the thermal stress [2]. Therefore, development of alternative permeation reduction methods is desired, although primary method is still oxide coating. In this study, possibility of metal coatings on F82H as the tritium permeation reduction coating was examined by means of deuterium permeation experiment. Metal coatings such as copper, aluminum and gold plating of 10 μm thickness on outer surface of the F82H tube (250mm length, 10mm diameter and 1mm thickness) were prepared as the permeation reduction coating. Additionally, palladium coating of 1 μm thickness on the F82H tube was also prepared in order to evaluated the permeability of F82H eliminating the surface effect on the permeation behavior. In the permeation experiment, deuterium gas was filled inside of the specimen tube up to designated pressure (1.3 – 100kPa) at constant specimen temperature (453 - 713K), and permeated deuterium through the specimen to the outer side was measured by a quadruple mass spectrometer. Permeation Reduction Factor (PRF) of the metal coatings was evaluated by comparing the steady state permeation flux between metal plated specimens and palladium coated specimen. As the results, the PRF of the metal coatings at 590K were 5, 100 and >1000 for copper, aluminum and gold plating, respectively. Those results indicate the possibility that aluminum and gold plating could be applied in the tritium system as the alternative permeation reduction method, although it should be avoid applying in the neutron fields.

[1] H. Nakamura et al., Fusion Eng. and Des., **81** (2006)1339–1345.
[2] H. Nakamura et al., Fusion Sci. and Technol., **54** (2008)341-345 .