§24. Fuel Hydrogen Retention of Tungsten Coated CFC for Helical Type Reactor

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In the helical reactor to make good magnetic fields and to obtain an accessibility of the heating system, the thin wall thickness is desirable. As the wall material, tungsten (W) is candidate because of low erosion yield and small amount of tritium retention. However, the wall becomes heavy and the cost is high if used as bulk W material. If tungsten coated carbon fiber material (CFC) is applied, the wall weight can be significantly light and the use of expensive tungsten can be saved.

In the present study, the tungsten coated CFC (W/CFC) supplied by Toyo Tanso Co. was employed to evaluate the fuel hydrogen retention properties. The W/CFC was manufactured by brazing W sheet produced by plasma sintering on CFC (CX2002U). The mass density of the tungsten sheet is high, so that the thermal conductivities of both W and CFC are quite high.

The W surface was irradiated with deuterium ions of 1.7keV, using an ECR ion source. The thicknesses of W and CFC were 1 mm and 5 mm, respectively. The sample temperature was room temperature (RT). After the irradiation, the deuterium retention properties were examined using thermal desorption spectroscopy (TDS). The irradiation was repeated by changing the ion fluence up to $2x10^{18}$ D/cm^2.

Fig. 1 shows the desorption rate of deuterium in the irradiated W/CFC with different ion fluences [1]. The large desorption peak at 250°C is regarded as desorption of deuterium trapped in the defect. Fig. 2 shows the amount of retained deuterium against the ion fluence [1]. For comparison, in this figure the data of crystalline W (W) (Nilaco), sputter-coated W on reduced activated ferritic steel (F82H) (W/F82H), and F82H are presented [2]. The amount of W/CFC saturated with about $1x10^{18}$D / cm^2. The saturated amount was small, similar with crystalline W and F82H.

As described above, the present results show that fuel hydrogen retention of W/CFC is small as crystalline tungsten and reduced activated ferritic steel. Thus, the hydrogen recycling characteristic and the in-vessel tritium inventory are similar with cases of ferritic steel and crystalline tungsten. The present W/CFC has quite high thermal conductivity both in W and CFC, in addition to the light weight. Therefore, we here propose to apply this W/CFC for the plasma facing walls in the helical and tokamak reactors.

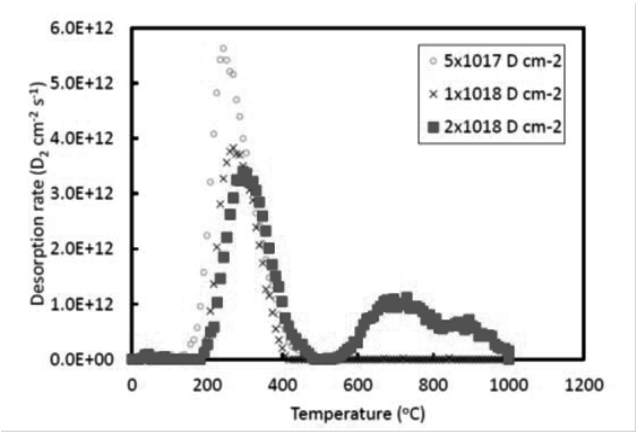

Fig.1 D_2 desorption spectra of deuterium-irradiated W/CFC.

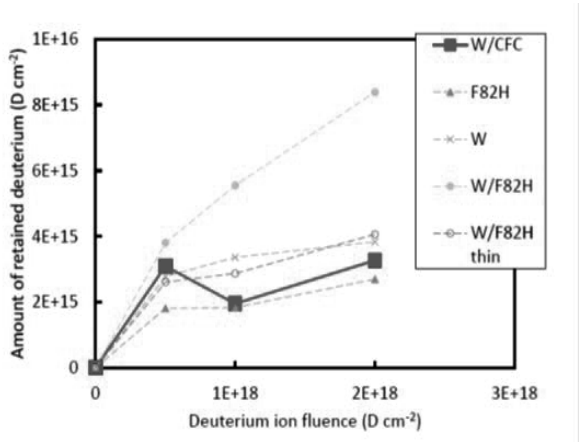

Fig.2 Fluence dependences of amount of retained deuterium for various samples.

1) Yamauchi, Y. et al, To be submitted (2016).
2) Armando, M., Yamauchi, Y., Tsuchiya, A. Nobuta, Y., Hino, T., Plasma and Fusion Research **8**(2013)2405103.