§25. Characterization of Re-deposition Layer with Ferritic Steel in JT-60U

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The plasma facing materials (PFMs) in next generation fusion devices, such as ITER and FFHR [1] will be exposed to severer heat load and neutron flux than those in current devices. Thus, low-radio activate ferritic steel has been developed for PFMs or base materials with high Z coating.

In JT-60U tokamak, graphite tiles had mainly been used for PFMs. In 2005, additional 1122 ferritic steel tiles of 8%Cr, 2%W and 0.2%V, which cover about 9.1% areas of the torus, were installed. After this installation, the toroidal magnetic field ripple was reduced by a factor of about 4, and a decreasing of the fast ion loss and improvements of plasma confinement were observed [2]. Although additional metaric depositions of impurities were observed on in-vessel components, sufficient data of these re-deposition layers was not provided yet.

Material probes made of SS 316L, graphite and Si samples were installed on the outer port inside the vacuum vessel as shown in Fig.1, and were exposed to 1328 deuterium plasma discharges during one experimental campaign. These sample holders were installed at different 5 toroidal positions before and after installation of ferritic tiles, and fresh samples into these holders were set for each campaign. Depth profiles of their impurities on these samples were analyzed using the X-ray Photoelectron Spectroscopy (XPS) [3] with Ar gun's sputtering.

For example, an iron atomic concentration of 45 % was observed after ferritic tile installation at P-15 section, where thick carbon deposition layer was also found before and after ferritic tile installation as shown in Fig.2. At the same depth of 2 nm from the top surface, carbon of 34 %, oxygen of 15 %, boron of 6 % are observed after ferritic tile installation. A thickness of deposition layer is about 12 nm and it is similar on each sample before and after ferrite tile installation at P-15. Results of XPS analysis showed the different atomic concentrations of iron due to erosion of ferritic tiles in every position of the torus.

This ferritic steel tile contains 2% of tungsten in wt and a tungsten coating material was used for the divertor target tiles in this experimental campaign. However tungsten element was not observed from any samples.

From these results, it is shown that deposited layer of iron was found after ferritic tile installation. Initial atomic concentrations of ferritic steel were not kept due probably to long-term erosion/deposition processes. The distribution of thickness of deposition layer after the ferrite tile installation was similar to that before the ferrite tile installation.

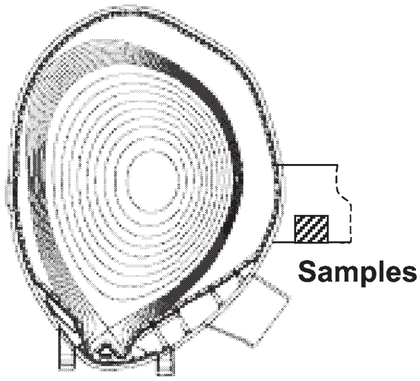

Fig.1 Poroidal cross-section in JT-60U. Sample holders were installed at outer port inside the vacuum vessel

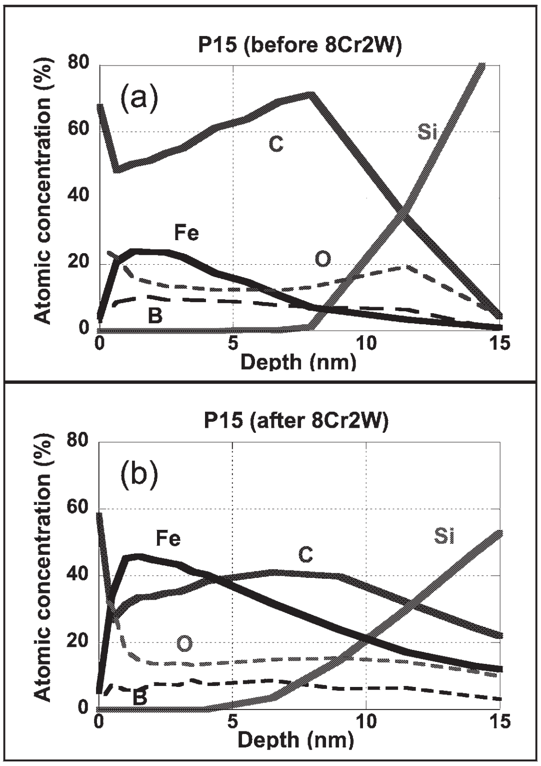

Fig. 2. Depth profiles of deposition layer on Si sample (a) before and (b) after ferritic steel tiles installations at P-15 section in JT-60U. Depth 0 mm indicates as the top surface of sample.

[1] A. Sagara et al., Fusion Eng.Design, **83** (2008) 1690.
[2] H. Takenaga et al, Nuclear Fusion **47** (2007) S563.
[3] N. Ashikawa et al, J. Nucl. Materials **363-365** (2007) 1352.