§11. Study on Plasma-Wall Interaction and Core-Edge Coupling in GAMMA10

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A stable steady state operation is a critical issue for a future fusion device. The issue contains not only subjects related to the core plasma such as confinement, heating and current drive but also those related to the plasma-wall interaction (PWI) such as hydrogen recycling. An objective of this research is to study plasma-wall interaction and core-edge coupling through experiments in GAMMA 10.

In this time, long-term samples and a surface probe were utilized for the first time in GAMMA 10.[1] The surface probe was installed at the horizontal port and the material sample attached on the tip of the probe could be taken form the vacuum vessel after a short experimental period. Two long-term samples were installed on the vacuum vessel wall. Installation locations of them are shown in Fig. 1. Distance between them was 1.2 m. These samples were exposed to the central plasmas during the whole experimental campaign of which total discharge duration was about 370 s. The central plasmas were mainly heated with ICRF and its ion temperature was typically several keV.

Figure 2 shows sample holders with thinned material specimens (tungsten and stainless steel) for TEM observation. It is found that the sample holder that was set at the central position became dark, but on the other hand the color of the sample that was set at the east position was not changed, indicating that deposition occurred at the central part of the central cell.

Figure 3 shows results of TEM observation for thinned tungsten specimens. Dislocation loops are observed in both specimens at the central and east positions. The dislocation loop must be produced by the high energy charge exchange neutrals. The number of dislocation loops of the central specimen is much larger than that of the east one, indicating that charge exchange neutral flux from the plasma at the central position was much higher than that from the plasma at the east position. Cross-sectional view of the TEM images show that thickness of the deposition layer on the specimen is 8 nm for the central specimen and 1.8 nm for the east specimen. It is consistent with observation of color of the sample holder shown in Fig. 2. The diffraction pattern of the central position suggests that oxidized iron is a dominant component of the deposition layer.

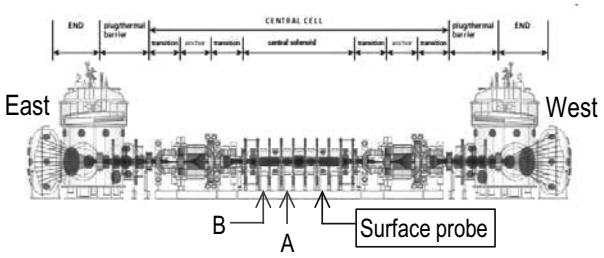


Fig.1 Schematic view of GAMMA 10 and locations of long-term samples (A, B) and a surface probe.

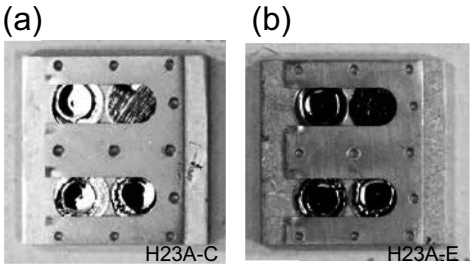
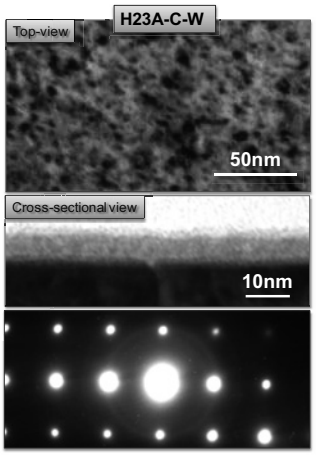


Fig.2 Sample holders with TEM specimens (a) at the central position indicated with "A" in Fig. 1 and (b) at the east position indicated with "B" in Fig. 1.

(a)



(b)

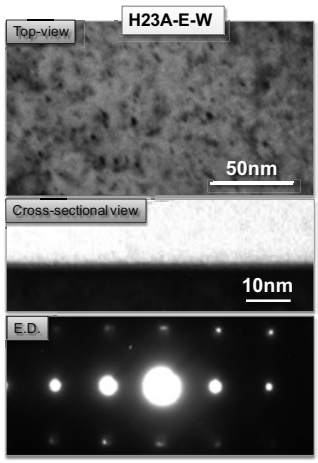


Fig. 3 Top view and cross-sectional view of TEM images, and electron diffraction pattern of (a) the thinned tungsten specimen that was set at the central position and (b) that at the east position.

1) Sakamoto, M., et al.: 29th JSPF Annual Meeting, Fukuoka (2012) 27E38P.