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Pilot-PSI装置における定常・パルス複合プラズマ照射による Al 被覆W材料の蒸気層形成実験

Vapor formation on aluminum coated tungsten materials exposed to steady-state/pulse combined plasmas in Pilot-PSI

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In ITER, plasma-facing components (PFCs) are exposed to steady-state and transient plasma loads such as edge localized modes (ELMs). The predicted heat flux of steady-state is 5–10 MW m^{-2} and the predicted heat load and time duration of ELMs are 0.2–2 MJ m^{-2} and 0.1–1 ms, respectively [1]. It is concerned that the PFCs in ITER could be eroded due to transient heat loads. Thus, it is important to investigate the dynamic behaviors of melting layer and the vapor formation. We have carried out simulation experiments of transient heat loads using a magnetized coaxial plasma gun device at the Univ. of Hyogo [2]. For simulating realistic condition of the PFCs, we have also started steady-state and pulse combined plasma irradiation experiments on Pilot-PSI at DIFFER.

Figure 1 shows the schematic view of Pilot-PSI. The linear plasma was generated by a cascaded arc source and confined by an axial magnetic field of ~ 1.6 T in this experiment. The plasma diameter was ~ 10 mm. Not only bulk materials but also aluminum (Al) film deposited samples were used in order to obtain Al vapor formation efficiently. The Al film with a thickness of 1–3 μm was prepared on a substrate using a magnetron sputtering device in Osaka University. The Al emission from the Al vapor was observed using a high-speed visible camera with and without a band pass filter, and a spectrometer. Figure 2 shows the Al optical emissions from Al vapor observed by the spectrometer. The Al neutral and singly-ionized Al ion emissions were observed. In addition, we measured surface IR emission by using fast IR camera to obtain surface temperature during pulsed plasma irradiation. The details will be presented at the conference.

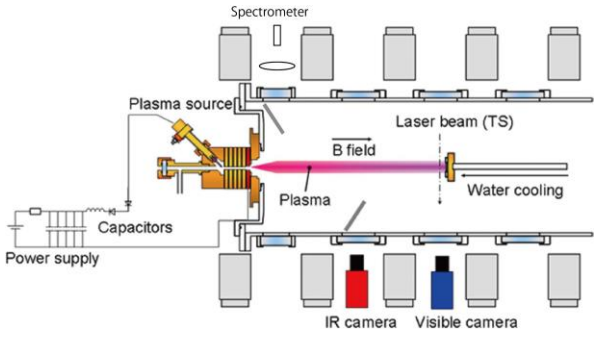

Fig. 1 Schematic of Pilot-PSI

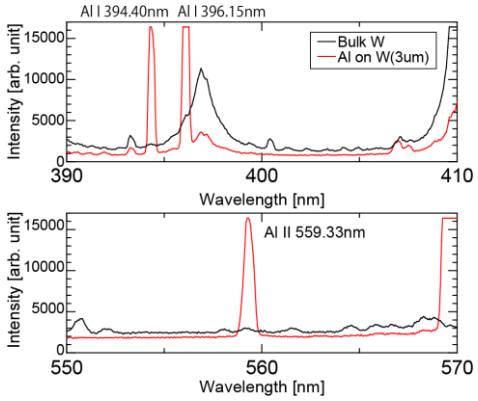

Fig. 2 Al emission spectrum

[1] G. Federici et al., Plasma Phys. Controlled Fusion **45** (2003) 1523.
[2] Y. Kikuchi et al., Proc. of 24th IAEA FEC, San Diego, USA, Oct. 8-13, FTP/P1-10 (2012).