§13. Behavior of Wall Material Impurities Released to Magnetized Plasma and its Effects on Plasma Properties

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GAMMA-10 end plasmas have several advantages in making plasma materials interaction experiments comparing linear plasma devices such as high ion energy with Maxwell distribution and presence of a high magnetic field. Erosion and material migration have been studying in the unique device. These results are valuable for material migration modeling and validation of atomic data in plasmas.

In this study, chemical sputtering of graphite and local transport phenomena of carbon atoms together with high Z atoms are investigated. Graphite and Mo samples were installed at the E-divertor test section with a sample surface tilted 45 deg from magnetic lines of force. Erosion flux of carbon and Mo will be measured by a framing camera with an appropriate spectral line filter. We also employed spectrometer to observe lights emitted from eroded atoms from the samples. Roof limiter used in this study is shown in Fig. 1, which was installed at the top of V shaped divertor test modules and exposed to plasma only this study.

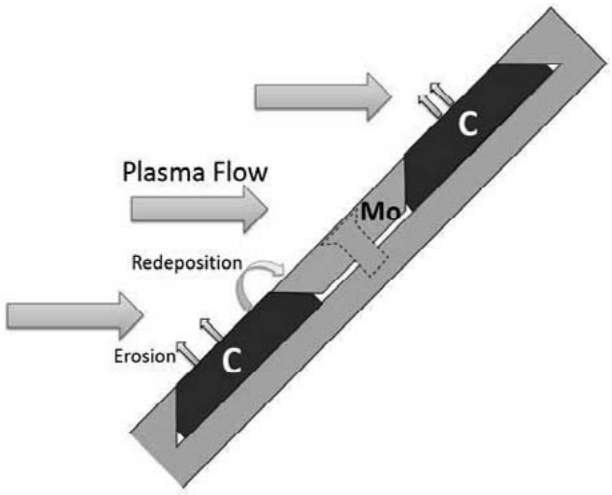

Fig. 1 Sample holder for this study. No heating device is attached.

Near the lower carbon plate, spectrum of emission light was observed. The result is shown in Fig. 2. This spectrum was observed in a ICRF heating phase (no ECR heating). Most strong lines are seen around 360 nm,

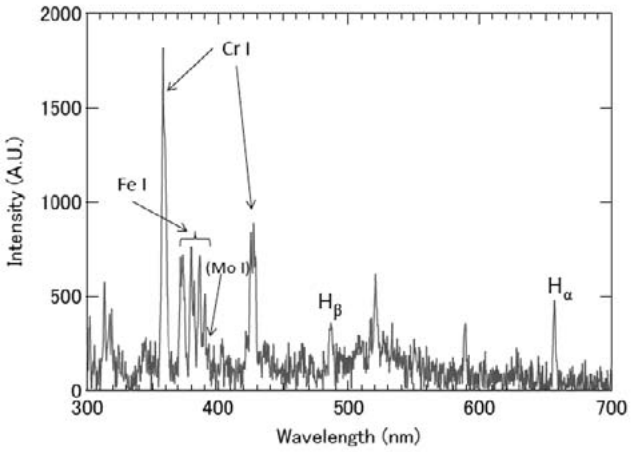

Fig. 2 Emission spectrum from plasma near the carbon target

370~390 nm, and 430 nm. According to the spectrum table, these lines are probably those from Cr and Fe atoms. These candidate lines are shown below.

Cr :

Cr I : 3578.682 (1000), 3593.481 (800), 3605.320 (600), 4254.331 (1000), 4274.806 (800), 4289.733 (500)

Fe :

Fe I : 3719.935 (600), 3734.864 (700), 3737.132 (600), 3745.5613 (600), 3748.2622 (300), 3749.4854 (400), 3758.2329 (300), 3820.4253 (500), 3859.9114 (500), 3886.2822 (300), 4045.8125 (300)

MoI line should appear around 390 nm, but this is not clear. Most of first walls of GAMMA10 is made of stainless steel, which contains Fe and Cr. These ions migrate along plasma flow to the target, then re-eroded these atoms could be emitted. Next year we will measure surface composition of carbon and Mo plates to study more details about Fe and Cr deposition. At this moment, carbon sputter erosion was not seen clearly, but there should be some amount of carbon sputtered by plasma impact. We also observe carbon redeposition on Mo and SUS base plates to study short range migration.

Same as last year, we also hold the meeting to exchange information and discuss details and future works. Topics are (1) edge plasma and divertor experiments in LHD, (2) PWI studies using unique plasma devices (Plasma gun, a PID plasma device), (3) presentation and discussion of ITPA meetings and ITER-STAC meeting. (4) status of divertor engineering design of ITER and DEMO, (5) tungsten plasma facing materials study, (6) plasma spectroscopy. Many participants attended and discussed intensively about these issues. This opportunity is very valuable for fusion plasma and engineering community and we continue to hold this meeting in the next year.