§9. X-ray Emissions from Tungsten Injected Plasma in LHD

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X-ray emissions from high-Z tungsten injected plasma has been measured with an assembly of x-ray pulse-height analyzer developed in Large Helical Device (LHD)[1]. As an x-ray detector, a 5-mm-thick-solid-state-lithium-drift-silicon censer cooled by liquid nitrogen has been used with a pulse height analyzer (PHA). The assembly is equipped with three detectors to measure x-ray spectra with three vertical chords of 300 mm intervals[1]. The electron temperature at the plasma center is 3.5 keV, as is shown in Fig.1(a). The tungsten has been injected as a pellet into LHD plasma.

In the present article the experimental results on x-ray measurement for the tungsten pellet injection are rapidly reported.

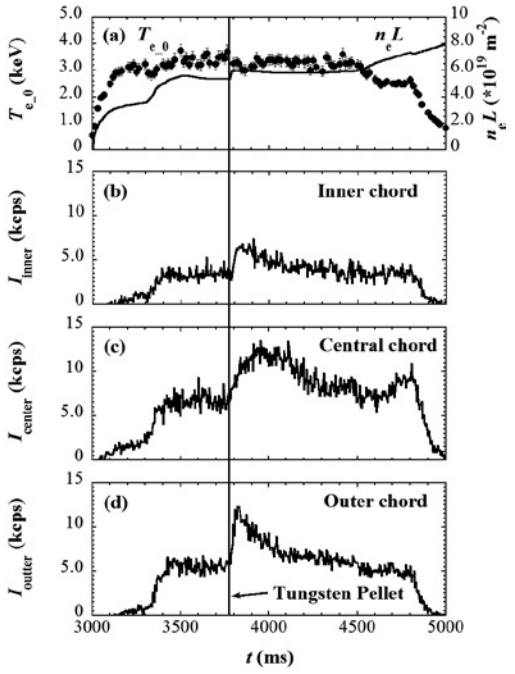

FIG.1. Time evolutions of the electron temperature and density at the plasma center (a), the time evolution of the integrated x-ray spectrum measured through inner chord at a radial position of R = 3421.13 mm with 1.0-mm-thick-beryllium filter (b), through central chord at a radial position of R = 3721.13 mm with 1.0-mm-thick-beryllium filter (c), through outer chord at a radial position of R = 4021.13 mm with 0.5-mm-thick-beryllium filter (d), respectively. The solid circles and line represent electron temperature and density, respectively. The straight vertical line indicates the timing of the tungsten-pellet injection. The central chord passes close to the plasma center which is corresponding to a vacuum-magnetic axis of R_{ax} = 3600 mm. Another chord passes through the peripheral region of the plasma.

The time evolution of respective x-ray intensity measured through each chord is simultaneously rising up just after the tungsten injection, since x-ray intensities shown in Fig.1 (b), (c), and (d) are line integrations through the chords. After the injection the intensities approximately become two times larger at peaking times. However, the peaking times are different due to the particle penetration in accordance with a transport[2].

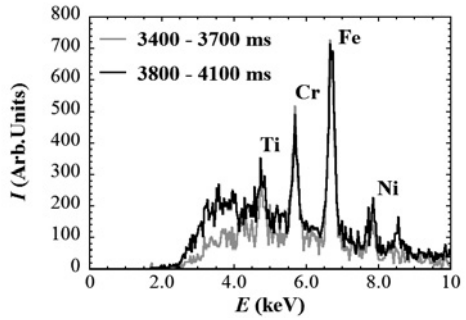

FIG.2. X-ray spectra measured through the central chord before and after the tungsten pellet injection. The solid and gray lines represent the spectra after and before the injection, respectively. The integration time for respective spectrum is 300 ms. The x-ray intensity lower than 3.5 keV is strongly absorbed by the beryllium filter.

Figure 2 shows the x-ray spectra measured through the central chord just before and after the tungsten injection. The spectrum increases after the pellet injection as is also shown in Fig.1(c).

In the x-ray ranges around 3.5 keV and 8.5 keV, lines emitted from tungsten ion are predicted to appear[3]. Basically, lines are estimated in comparison with the spectra before and after the pellet injection. Currently, the estimation is being carried out.

1) Muto, S., *et al.* : Rev.Sci.Instrum.**72**(2001),pp.1206-9.
2) Muto, S., *et. al.* : Plasma and Fusion research **2**,(2007) S1069(3pp).
3) Biedermann, C., *et al.* : Phys.Scr.**T134**(2009)014026 (6pp).