§22. Study of Impurity Radiation with a Multilayer Mirror

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A soft X-ray spectrometer using a multilayer mirror (MLM) that consists of silicon and tungsten layers with measurable photon energy in the range from 300 to 1000eV was used to measure the soft X-ray spectra on CHS. The reflectivity is 7~20% and the energy resolution is 15~25eV in this energy range. The spectrometer is equipped with a 8μm Beryllium filter to remove low energy photons of less than 500eV and a 20-channel PIN diode array. The electron temperature can be calculated assuming that the soft X-ray spectrum measured by this spectrometer does not contain line emission, but the obtained temperature did not agree with that obtained with Thomson scattering.[1] A possible interpretation is the contribution of line radiation.

Normal CHS plasmas with vacuum magnetic axis position R_{ax}=92.1cm is in contact with the inner wall of the vacuum vessel. The more the plasma shifts outward (from 92.1cm and 99.5cm), the less impurity line radiation is emitted in the energy range from 640 to 800eV. Figure 1 shows energy spectra for discharges with R_{ax}=92.1cm and R_{ax}=99.5cm. The electron temperature is 400eV and the electron density is $6 \times 10^{19}(m^{-3})$. It is found that impurity radiation is larger for plasmas with R_{ax}=92.1cm than those with R_{ax}=99.5cm. In the latter case, the plasma does not touch the inner wall and has a separatrix configuration. The radiation loss in the energy range from 640 to 800eV is 260nW for discharges with R_{ax}=92.1cm and 110nW for those with R_{ax}=99.5cm. These observations suggest that impurities generated by sputtering flow into the CHS plasma. The sputtering effect for R_{ax}=92.1cm is larger than that for R_{ax}=99.5cm. In CHS, Ti gettering is routinely used for wall conditioning. The dominant impurities are titanium and oxygen but the two line radiations (690eV and 770eV) have not been identified. The relationship between impurity line radiation and plasma-wall interaction is a future research task. The dependence on R_{ax} suggests that we can measure the electron temperature in case of separatrix configuration using an appropriate energy range.

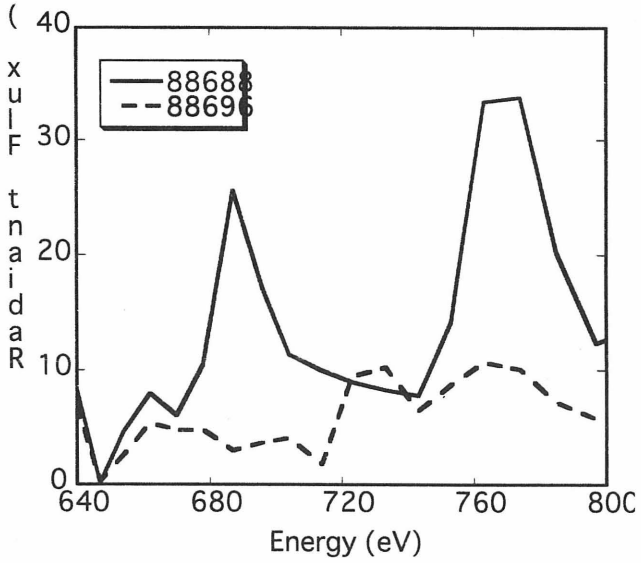

Fig. 1. Energy spectra of discharges with R_{ax}=92.1cm (red line) and R_{ax}=99.5cm (blue line).

Reference

1) Smita, D., et al., Rev. Sci. Instrum. **72**, (2001) 1183.