§14. Volumetric Plasma Recombinations in Detached Recombining Plasmas

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In recent years, volumetric plasma recombinations have attracted considerable interest in detached plasmas observed in tokamaks with a magnetic divertor and in linear divertor plasma simulators. The volumetric plasma recombination is expected to play an essential role on strong reduction of ion flux, resulting in a decrease in the heat flux to plasma-facing components because of the dissipation of the ionization potential induced by the surface recombination.

In order to make a comprehensive study on the plasma volumetric recombinations in the detached plasmas, we have developed the modified TP-D DC plasma source as shown in Fig. 1, which is designed to improve the ionization efficiency using a *heated* LaB_6 disk cathode [1]. The improved DC plasma source makes it possible to generate high density hydrogen plasmas, which can not be obtained in the conventional TP-D plasma source because of the high breakdown voltage.

Figure 2 shows a spectrum of the visible light emissions from detached helium plasmas at a helium gas pressure P_n ~ 5.4mTorr by feeding helium neutral gas. Line emission from highly excited levels of helium atoms up to $n = 21$ and continuum spectrum were clearly observed [2]. This result indicates three-body and radiative recombinations near the target with puffing helium neutral gas. The detailed analysis of the spectrum gives very low electron temperature less than 0.5eV. The electron energy loss is caused by energy transfer to the neutral through the electron-ion energy relaxation and charge exchange [2, 3].

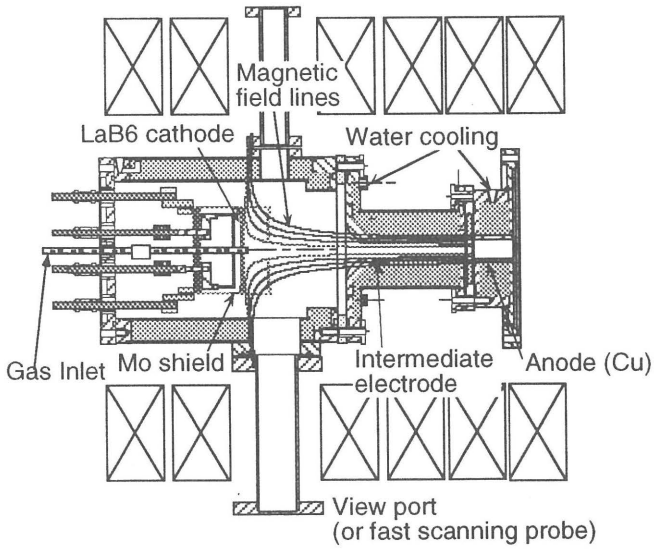

Fig. 1. Schematic diagram of improved TP-D plasma source.

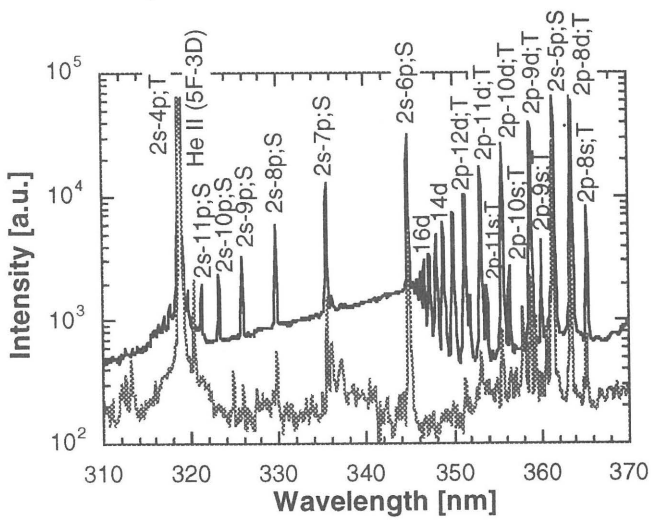

Fig. 2. Emission spectra from downstream location at 5.4mT in neutral pressure (solid line) and at 1.0mT (dashed line) on 5sec in exposure time.

Reference

1) S. Narita *et. al.*, Proc. of the Int. Conf. on Plasma Physics, Nagoya, 2(1996)1362.
2) J. Park *et al.*, Phys. Rev. Lett. *submitted.*
3) N. Ezumi *et al.*, J. Nucl. Mater. *to be published.*