Comparative study of detached H/D plasmas using laser Thomson scattering and spectroscopy in the linear plasma divertor simulator NAGDIS-II

Jielin Shi[1,2*], Hideki Kaizawa[1], Hirohiko Tanaka[3], Shin Kajita[4], Noriyasu Ohno[1], Hongbin Ding[2]

[1]*Graduate School of Engineering, Nagoya University, Nagoya 464-8603, Japan*
[2]*School of Physics, Dalian University of Technology, Dalian 116024, China*
[3]*Institute of Materials and Systems for Sustainability, Nagoya University, Nagoya 464-8603, Japan*
[4]*Graduate School of Frontier Sciences, the University of Tokyo, Kashiwa, Chiba 277-8561, Japan*

Plasma detachment is a necessary condition for fusion device operation and hydrogen isotopes are the main component of fusion plasmas. To investigate the isotope effect on the plasma detachment in hydrogen (H) and deuterium (D) plasmas, the stable H and D plasmas were generated in the linear plasma device NAGDIS-II [1], and different detachment degree were achieved by controlling the neutral pressure. The radial distributions of the electron temperature (T_e) and the electron density (n_e) were measured by upstream and downstream laser Thomson scattering (LTS) systems [2] and the spectrum of Balmer series and Fulcher-α band were measured by optical emission spectroscopy (OES) [3]. In the plasma recombination region (downstream), T_e decreases from several eV to 0.1eV, and n_e is about 10^{18} m^{-3}. A distinct variation in the distribution of the atomic state population densities was observed. The results indicated that the dominant mechanism of the plasma recombination transitions from molecule activated recombination (MAR) to electron ion recombination (EIR) with increasing neutral pressure. Exhaustive plasma parameters of the recombination process are measured in both H and D plasma, from the MAR phase to the EIR phase. Analysis of isotope effects and mechanisms will be presented.

[1] N. Ohno, *et al.,* Phys. Rev. Lett. **81**, (1998) 818–821.

[2] S. Kajita, *et al.,* Phys Plasmas **24**, (2017) 073301.

[3] H. Tanaka, *et al.,* Nucl. Mater. Energy **19**, (2019) 378.

*Presenting author: jlshi@mail.dlut.edu.cn