Laser Thomson Scattering Measurements around Magnetized Model in Rarefied Argon Arc-jet Plume

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Magnetohydrodynamic aerobraking [1] is attracting attention as a thermal protection system for atmospheric entry vehicles. This system uses the Lorentz force to control the weakly ionized plasma generated around the vehicle during atmospheric entry. To investigate the mechanism of the Lorentz force generation at high altitudes, where the Hall effect is dominant, we measured the electron temperature and density around a magnetized model with 0.35 T in a rarefied supersonic argon plasma using the non-collective laser Thomson scattering (LTS) method, which uses a triple-grating spectrometer with a Rayleigh block [2]. We compared the measurements with a detailed computational fluid dynamics (CFD) analysis [3]. Figure 1 compares the radial distributions of the electron temperature and density in the LTS and CFD. Without the magnetic field, the CFD overestimated the electron temperature of the LTS by only about 500 K and reproduced its radial distribution well. With the magnetic field, the LTS measurements showed an increase in electron temperature only at r=0 mm and a sharp decrease with radial direction. On the other hand, the CFD values showed an overall increase in electron temperature. The radial distribution of the electron density showed a negligible effect on the magnetic field, and the LTS and CFD values were in excellent agreement.

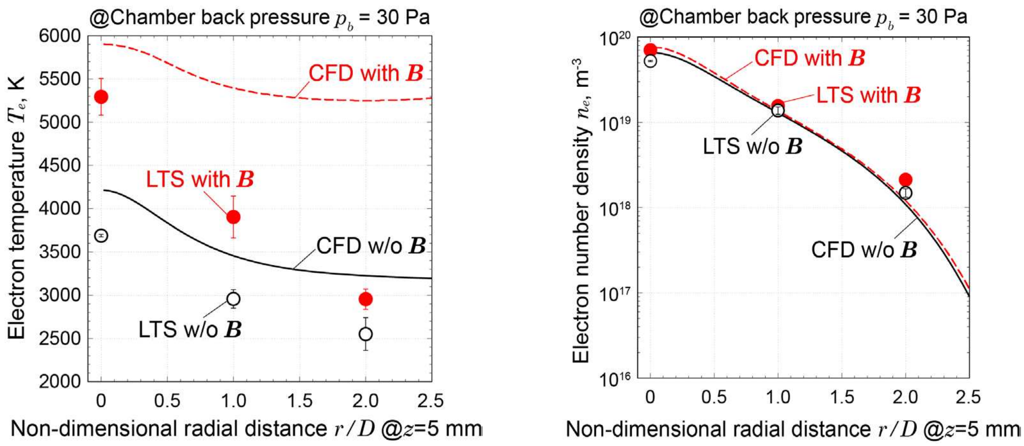

Figure 1. Comparison of radial distributions of electron temperature and density in LTS and CFD.

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[2] K. Tomita, *et al.,* Plasma Fusion Res. **12** (2017) 1401018.

[3] H. Katsurayama and T. Abe, J. Appl. Phys. **113** (2013) 053304.

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