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Measurements on Nanosecond Pulsed Streamers Using Laser Thomson Scattering

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Development of nonlinear ionization waves in the initial stage of electrical breakdown known as streamer discharges or primary streamers in a non-ionized medium, followed by the creation of a weakly-ionized non-equilibrium plasma [1]. Measurements of electron density (n_e) and electron temperature (T_e) are important to understand the basic structure of the streamer as well as the industrial applications of streamers. Laser Thomson scattering (LTS) has been known as one of the most reliable methods to measure the n_e and T_e of plasmas [2, 3]. It has been employed for the study of the streamer moving toward the cathode in helium near atmospheric pressure.

The light source of LTS is the second harmonics Nd:YAG laser. Also a triple grating spectrometer (TGS) having high rejection rate for stray light is used to measure LTS spectra. The pulsed discharge is generated in helium gas at a pressure of 250 Torr with a peak value of 3 kV at a frequency of 10 Hz. The electrode set in this experiment is consisted of a needle electrode and a hemispherical electrode with an inter-electrode gap of 16 mm.

In order to avoid laser perturbation and obtain sufficient intensity of the Thomson scattering signal, two cylindrical lenses were used to optimize the spot size of a probing laser at a focusing point. Figures 1 and 2 show the temporal evolution of n_e and T_e at the point of 2 mm from the needle electrode.

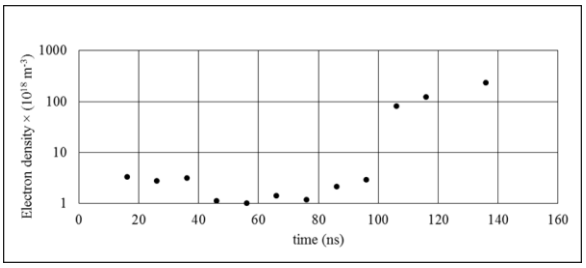

Fig.1 Temporal evolution of electron density in the streamer.

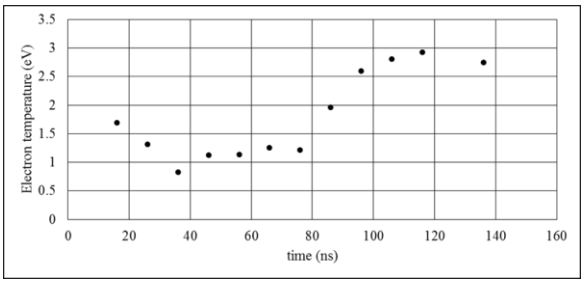

Fig. 2 Temporal evolution of electron temperature in the streamer.

References

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