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Incoherent laser Thomson scattering diagnostics for streamer discharge in He gas

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Streamer discharge plasma, a type of non-thermal plasma, has received global attention as a source of reactive radicals, and is used for many applications such as ozone generation, decomposition of NOx and other gas pollutants, cleaning water, disinfection, deodorization, and medical applications. The tip of streamer discharge, known as the streamer head, in particular contributes to radical production. The peak electric field is located in the streamer head on the axis of symmetry of the discharge, likely resulting in many radical types. Very remarkable results in NO removal efficiency and superior ozone generation yield performed by streamer discharge have reported. Improving gas treatment methods requires understanding of physical characteristics of streamer discharge and streamer head, for example, electron temperature and electron density.
This study investigates characteristics of streamer discharge by observing the propagation process of streamer head in a needle to conic electrode with positive voltage using a high speed gated emICCD camera. Then, incoherent laser Thomson scattering (LTS) diagnostic for streamer discharge and streamer head with positive voltage was performed. LTS diagnostic is considered to be the most reliable technique measuring electron temperature and density in plasma simultaneously. In addition, LTS diagnostic has high resolution temporally and spatially, therefore, LTS diagnostic can measure location dependence of electron temperature and density in streamer discharge including streamer head. The measurement point was 1 mm and 2 mm from tip of the high voltage needle electrode, and Thomson scattering signals were measured at the point of initial phase of streamer head propagation. In the results, electron temperature of streamer discharge was 3 ˜8 eV, electron density of streamer discharge was 1020 m-3 ˜ 1021 m-3 order. This study has proven that LTS diagnostic can measure electron temperature and density in streamer discharge plasma.

Author: EGUCHI, Kyohei (Graduate school of Science and Technology, Kumamoto University - Japan)

Co-authors: Mr FUJITA, Ryo (Graduate school of Science and Technology, Kumamoto University - Japan); Prof. WANG, Douyan (Institute of Pulsed Power Science, Kumamoto University - Japan); Prof. TOMITA, Kentaro (Interdisciplonary Graduate School of Engineering Science, Kyushu University- Japan); Prof. NAMIHIRA, Takao (Institute of Pulsed Power Science, Kumamoto University - Japan)

Presenter: EGUCHI, Kyohei (Graduate school of Science and Technology, Kumamoto University - Japan)

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