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Laser diagnostics on atmospheric-pressure low-temperature helium pulsed plasmas in room- and cryogenic-temperature environments
NORITAKA SAKAKIBARA, HITOSHI MUNEOKA, KEIICHIRO URABE, RYOMA YASUI, KAZUO TERASHIMA, The University of Tokyo — In atmospheric-pressure low- temperature plasmas, the control of the plasma gas temperature (T_g) by a few kelvin is considered to be crucial for their applications to novel materials processing such as bio-materials. However, there have been only few studies that focused on the influence of T_g on the plasma characteristics. On the other hand, it was reported that helium metastables played a key role in the dependency of chemical reactions on T_g in helium-nitrogen plasmas. In this study, laser diagnostics were carried out in atmospheric-pressure helium pulsed plasmas near or below room temperature, at 340−100 K. Parallel electrodes of copper rods (diameter: 2 mm) with a gap distance of 535 μm were used and pulsed discharges with a pulse width of a few hundred nanoseconds were generated inside a reactor. The density and lifetime of helium metastables were estimated by laser absorption spectroscopy measurements and T_g was evaluated by near-infrared laser heterodyne interferometry measurements. At 300 K, the helium metastable density was 1.5×10^{13} cm^{-3} while the lifetime was 3.1 μs, and increase in T_g was up to 70 K. Dependency of the density and lifetime of helium metastables on T_g was observed and also discussed.

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