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Experimental and Numerical Investigation of the Dependency of Reaction Dynamics on the Plasma Gas Temperature in He/N_2 Cryoplasmas HITOSHI MUNEOKA, KEIICHIRO URABE, SVEN STAUSS, KAZUO TERASHIMA, Department of Advanced Materials Science, The University of Tokyo
— The plasma gas temperature (T_g) is one of the essential parameters in plasma science and technology, but so far, the effect of T_g on low-temperature high-gas-density plasma chemistry has not been investigated in detail yet. Cryoplasmas, which are defined as plasmas whose T_g can be controlled below room temperature (RT), have the potential for various applications. In this study, to investigate the effect of T_g on the reaction dynamics in He/N_2 cryoplasmas, we developed a new 0D reaction model and also investigated the cryoplasmas by time-resolved laser absorption spectroscopy (LAS) and optical emission spectroscopy (OES). LAS measurements in He cryoplasmas at the same gas density as at RT and 1 atm, showed a longer lifetime (>50 times) of metastable helium atom (He^m) at cryogenic temperature (CT) compared to those at RT. OES revealed a time delay of the N_2^+ emission peak relative to the He emission peak of a few microseconds, and the delay decreased with increasing T_g. The simulation using our reaction model suggested that the long lifetime of He^m at CT are due to the change of the reaction dynamics related to He^m as a function of T_g.

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