

# 低温 Ar プラズマにおける電子と準安定励起原子 Ar (1s<sub>5</sub>) の数密度相関

## Density-Correlation between Metastables and Electrons in Low-temperature Plasmas in Ar

慶應大理工

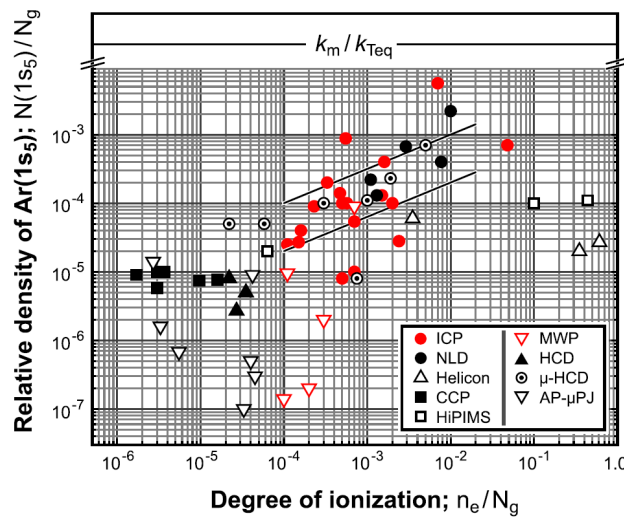
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There exist large number of experimental and theoretical studies of neutral metastables in Ar to explore and clarify the macroscopic and the microscopic characteristics of low-temperature plasma sources for over three decades. The accumulated set of data comprised of the number density  $N^*$  and temperature  $T_g$  of the metastable as well as the electron density  $n_e$  over a wide range of external parameters enable the analysis of the inner plasma parameter in the form of the relative densities,  $N^*/N_g$  and  $n_e/N_g$  normalized by the feed gas density  $N_g$ , based on a simple rate equation. That is,

$$\frac{n_e}{N_g} = -\frac{k_{mp}}{k_{Teq}} \frac{N^*}{N_g} - \frac{k_{mp}}{k_{Teq}} \left( \frac{k_m}{k_{Teq}} + \frac{I_d}{k_{mp}} \right) \left( 1 + \frac{k_m}{k_{Teq}} \frac{1}{\left( \frac{N^*}{N_g} - \frac{k_m}{k_{Teq}} \right)} \right).$$

A reasonable cross-correlation in the above equation, is found between  $N^*/N_g$  and  $n_e/N_g$  during a steady-



state under condition without three-body collision and diffusion, i.e.,  $I_d = 0$  in Ar (see above fig. [1]). A strong positive correlation between  $N^*/N_g$  and  $n_e/N_g$  demonstrates that the metastable density  $N^*$  can be an indirect indicator of the plasma density  $n_e$  in a low-temperature plasma. It will be noted, in addition, that the high-sensitivity of electrons to the surrounding local field makes it difficult to observe the local density and its distribution in a low-temperature plasma even though there exist several traditional methods to measure  $n_e$ . The details of the present result are published as the review article [1].

[1] T. Makabe; J. Phys. D **52** (2019) 213002, and **52** (2019) 259601.