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Correlation between electron temperature and plasma power in inductively coupled plasma[1] HYO-CHANG LEE, J. H. KIM, D. J. SEONG, K. H. YOU, CHAEHO SHIN, Korea Research Inst of Standards and Science (KRISS), DEUK-CHUL KWON, Plasma Technology Research Center, Nation Fusion Research Institute, B. H. SEO, S. J. OH, Applied Physics, California Institute of Technology, C.-W. CHUNG, Department of Electrical Engineering, Hanyang University — It is generally recognized that the electron temperature T_e either remains constant or decreases slightly with plasma power (plasma density). This trend can be simply verified using a single-step or multi-step fluid global model. In this work, however, we observed the abnormal behavior of T_e in ICP. In the low RF power or plasma density region, T_e decreased, while it increased in the high RF power region. It was also demonstrated from the laser Rayleigh scattering measurement that gas temperature slightly increased with low RF powers, and it significantly increased in the high RF power region. The kinetic model, which considers stepwise ionization and gas heating, was developed to analyze the change in T_e. From the kinetic model analysis, the apparently abnormal trend in Te can be understood by the contrasting effects of stepwise ionization and gas heating. It should be noted that the original notion was that Te is decoupled (or weakly coupled) to the plasma power or plasma density, and thus, Te must remain constant (or slightly decrease) with plasma density in the conventional global model. However, our experiments and improved modeling show that Te has a much stronger relationship with plasma power than we initially expected, and the gas heating effect should be considered [1]. [1] Lee et al., Appl. Phys. Lett. 110, 014106 (2017).

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