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Statistical Physics of Electron Temperature of Low-Pressure Discharge Nitrogen Plasma with Non-Maxwellian EEDF HIROSHI AKATSUKA, Tokyo Insitute of Technology, YOSHINORI TANAKA, Mitsubishi Electric Corp. — We reconsider electron temperature of non-equilibrium plasmas on the basis of thermodynamics and statistical physics. Following our previous study on the oxygen plasma in GEC 2015, we discuss the common issue for the nitrogen plasma. First, we solve the Boltzmann equation to obtain the electron energy distribution function (EEDF) $F(\epsilon)$ of the nitrogen plasma as a function of the reduced electric field E/N. We also simultaneously solve the chemical kinetic equations of some essential excite species of nitrogen molecules and atoms, including vibrational distribution function (VDF). Next, we calculate the electron mean energy as $U = \langle\epsilon\rangle = \int_0^\infty \epsilon F(\epsilon) \mathrm{d}\epsilon$ and entropy $S = -k \int_0^\infty F(\epsilon) \ln[F(\epsilon)] \mathrm{d}\epsilon$ for each value of E/N. Then, we can obtain the electron temperature as $T_{\mathrm{e}^{\mathrm{stat}=[\partial \mathrm{S}/\partial \mathrm{U}]^{-1}}}$. After that, we discuss the difference between $T_{\mathrm{e}^{\mathrm{stat}}}$ and the kinetic temperature $T_{\mathrm{e}^{\mathrm{kin}\equiv(2/3)\langle\epsilon\rangle}}$, as well as the temperature given as a slope of the calculated EEDF for each value of E/N. We found $T_{\mathrm{e}^{\mathrm{stat}}}$ is close to the slope at $\epsilon \sim 4$ eV in the EEPF.

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