N_2 dissociation and kinetics of $N(^4S)$ atoms in nitrogen DC glow discharge

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N_2 dissociation in pure nitrogen plasma has a long history of research. It seems to be a complex process which comprises many reactions involving various electronic and vibrational nitrogen states whose contributions can vary depending on conditions. Here we studied N_2 dissociation in the stationary N_2 discharge both experimentally and theoretically. We used a DC glow discharge in quartz tube in pure N_2 at moderate pressures (5 – 50 Torr). Dissociation degree, the atomic nitrogen loss frequency and gas temperature were measured by applying optical emission spectroscopy (OES) and as a result an "effective" rate constant for nitrogen dissociation was obtained in the wide range of reduced field E/N. The analysis of N_2 dissociation was carried out using specially developed 1-D radial self-consistent model which takes into account the spatially inhomogeneities of species concentrations, E/N, EEDF, T_{gas}, *etc* together with fairly complete plasma-chemical kinetics and all the known up-to-date cross-sections for electron kinetics. The model was successfully validated through the obtained experimental results for electric field, gas temperature and N atom density. The comprehensive analysis of closely coupled processes in nitrogen plasmas - ionization, gas heating and N_2 dissociation, were carried out. Simulations reproduced well the experimental data on and allowed us to evaluate contributions of different dissociation channels considered. It was shown that nitrogen dissociation in the stationary N_2 discharge is mostly provided by direct electron impact via the excitation of the pre-dissociative states N_2* from the vibrationally excited nitrogen molecules $N_2(X,\upsilon)$.

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