Electron kinetics IN GAS-discharge plasma of inert gases involving exited atoms

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Stepwise ionization in a gas discharge plasma of inert gases is analyzed under conditions where excited atoms give a contribution in atom ionization. This analysis is based on the self-consistent character of atom excitation [1], i.e. the energy distribution function of electrons falls sharply above the excitation threshold with an increasing electron energy, and this in turn leads to a decrease of the excitation rate. As a result, the population of highly excited atoms is low and they do not give a contribution to the ionization rate, and stepwise ionization is determined by four atom states which relate to the electron shell np5 (n + 1)s. Another peculiarity is that theoretical evaluations of the cross sections of electron-atom collisions are not reliable, whereas experimental data are scare. In this consideration, the inelastic electron-atom cross sections are found by continuation of the Born cross sections to low energy collisions with using the experimental cross sections for alkali metal atoms with s-p transitions of a valence electron [2]. One more peculiarity is that quenching of the lowest excited states of inert gas atoms consists in transitions from states of the electron shell np5 (n + 1)s to states of the electron shell np5 (n + 1)p under typical conditions of existence of this gas discharge plasma [3]. As a result, within the framework of the block model [4] with using blocks corresponded to the electron shells np5 (n + 1)s and np5 (n + 1)p we evaluate the concentration of excited atoms and the rate constant of stepwise ionization in a gas discharge plasma of inert gases for the regime of high electron concentrations where the Maxwell distribution function of electrons is realized for thermal electrons.

References

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