Inelastic processes in low-energy Li^+−Ar, K^+− Ar, and Na^+−He collisions

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In this study we report the measurements for absolute differential and total cross sections for charge-exchange, ionization and excitation processes in Li^+ -Ar, K^+-Ar, and Na^+-He collisions in the energy range of 0.5-10 keV. We have also measured the energies of the electrons liberated in the collisions and found that the energy of most of the liberated electrons are below 12 eV for the Li^+-Ar collision, within the interval 20 - 32 eV for the K^+-Ar collision system, and less than 17 eV for the Na^+-He collision. The measurements are performed under the same experimental conditions, using a refined version of the condenser plate method, the collision spectroscopy method with angle- and energy-dependent detection of the collision products, and the optical spectroscopy method, with an accurate calibration procedure of the light recording system. The comparison of our measurements with existing experimental and theoretical results are presented.
We construct the correlation diagrams for the $(LiAr)^+$and $(NaHe)^+$systems. The experimental data and the schematic correlation diagrams are used to analyze and determine the mechanisms for the charge-exchange, ionization and excitation processes. We found that the charge-exchange processes occur with high probabilities and electrons predominately are captured to the ground states of the resultant atom in the region of pseudocrossing of potential curves of S symmetry. The contribution to the charge-exchange cross section for the Li^+-Ar collision from the transition corresponding to R ~ 1.5 a.u. is the dominant one. The contributions of various partial inelastic channels to the total ionization cross section are estimated and primary mechanism for this process is defined. The contribution of the direct ionization process to the total cross section for the electron emission is the governing mechanism for the Li^+-Ar collision. The primary mechanism for the ionization in the K^+-Ar collision is connected with the decay of autoionization state. The ionization in the Na^+-He collision is related to a direct two electron excitation of the He atom in autoionization state: $Na^+ + He \rightarrow Na^+ + He^{**}(2s^2) \rightarrow Na^+ + He^+ + e$. On figure 1. We are presented results of measurements of ionization cross section for Li^+ -Ar, K^+-Ar, and Na^+-He system respectively.

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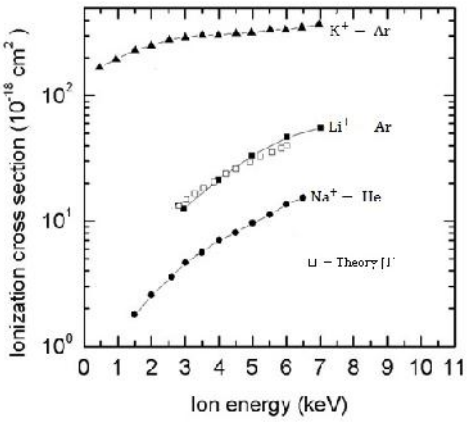

Figure 1. Dependences of the absolute ionization cross section on energy of ions

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References

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