Nanoscale physics

Spectroscopic study of Ar nanoclusters generated in a supersonic jet

O.Y. Tkachenko[1], Yu.S. Doronin[2], A.A. Tkachenko[2], V.L. Vakula[2]

[1] *V. Karazin Kharkiv National University, 4 Svobody sq., Kharkiv 61077, Ukraine*

[2] *B.Verkin Institute for Low Temperature Physics and Engineering of NAS of Ukraine, 47 Nauky Ave., Kharkiv 61103, Ukraine*
E-mail: doronin@ilt.kharkov.ua

VUV luminescence spectroscopy is a powerful tool for investigating the final step of relaxation of electronic excitations in rare-gas clusters.

In the present work, we study VUV cathodoluminescence spectra of Ar clusters produced in supersonic jets expanding into a vacuum. The measurements were performed at a stagnation pressure P_0 = 0.1 MPa and stagnation temperatures T_0 varying from 150 to 500 K. The maximum average cluster size amounted to 3000 at/cl at T_0 = 150 K. At a distance of 30 mm from the nozzle outlet, the supersonic jets were excited by an electron beam with an energy of 1 keV and current intensity of 20 mA. The resulting emission was spectrally dispersed by a monochromator and registered by a photomultiplier VEU-6.

In the 50-110 nm wavelength range of the spectra measured in the atomic and cluster regimes of jet flow, we observed lines of singly ionized argon (Ar II) and resonance lines emitted by the excited atoms ($^1P_1$ and $^3P_1$ states).

For the identified ion lines at λ=637 Å, λ=919 Å, and λ=932 Å, we measured dependencies of their intensity on the amount of matter condensed in the jet.

The analysis of the dependencies confirms the assumption that the curve peculiarities reflect the changes in the jet composition during the gas condensation. A high-temperature plateau in the dependency of the line at λ=637 Å suggests that the jet consists of atoms. The decrease in the line intensities occurring with lowering the stagnation temperature is indicative of cluster formation and can thus be used to estimate the amount of the condensed matter and the number of clusters in the jet.

1. *Verhovtseva E.T., Bondarenko E.A., Doronin Yu.S.* Size effect in the desorption of excited atoms and molecules from clusters of inert elements under electron bombardment // Low Temp. Phys.-2004.-**30**.-P. 34-50.