Nanoscale physics

Specific features formation of heterogeneous clusters in a supersonic gas jet

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Supersonic free jets [1] of rare gas clusters offer the possibility of isolating of molecules and complexes at very low temperatures, which are not accessible by other techniques.To understand the physical processes involved in heteroatomic clusters investigations, it is important to know the average size of the clusters and the dependence of the mean cluster size on expansion conditions.

In this paper clusters were studied using optical and electron diffraction techniques. The optical diagnostics employed the spectra of cathodoluminescence (CL) measured in the spectral range from 1050 to 2000 Å. This interval contains the bands of characteristic emission from excimer and exciplex molecules composed of Ar, Kr and Xe atoms. The average cluster size δ (in angstroms) was determined by the electron diffraction method [2]. In the case of pure icosahedral clusters, we used the well-known Hagena relation [3] between the cluster size and the values of P_0,T_0, and the nozzle parameters.

We have found that the key parameters needed for analysis the cluster composition are the critical cluster radius and the heavier component concentration in the gas mixture which can be used to establish the regions of existence of homogeneous and heterogeneous clusters. These critical values determine the coefficient of the enrichment of clusters with the heavier component respected to its concentration in the primary gas mixture. The obtained theoretical relations can be expected to be also valid for finding the composition of binary clusters of other Van der Waals systems.

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