Features of Accelerated Cluster Ion Beams

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Recently it was shown that gaseous accelerated cluster ion beams have some unique advantages for novel technologies of material processing and synthesis. The interaction of energetic cluster (complex consisting of hundreds or thousands particles) with surface is radically different from the tradition ion-solid collision. Almost simultaneous interaction of a large number of clusters of particles with roughly the same number of atoms in a solid leads to a high energy density and, consequently, to a strong nonlinear effects. Depending of the cluster size and specific energy, one can implement various methods of material modification and surface processing: low damage smoothing the surface of almost any material, including superhard ones (diamond, silicon carbide, etc.) down to the nanoscale level; low temperature deposition of thin films; shallow implantation [1 – 3].

The formation of accelerated argon cluster ion beams has been investigated experimentally with the aim of developing a laboratory bench for cluster-ion modification of materials. The experiments were performed on an experimental setup LEMPUS-1 [4]. To determine the optimal parameters for the formation of an intense cluster beam the measurements of the total intensity of the neutral molecular flow were made by varying the stagnation pressure P_0 and the nozzle-skimmer distance x_{ns}. The size distributions of ions in an accelerated cluster ion beam have been investigated by the retarding potential method at different stagnation pressures. It is shown that the mass spectrum of a accelerated cluster ion beam can be controlled by the conditions of ion beam formation. In addition, the influence of accelerated ion cluster beams on parameters of surface treatment were analysed.

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