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Production and Characterization of Small Metallic Clusters

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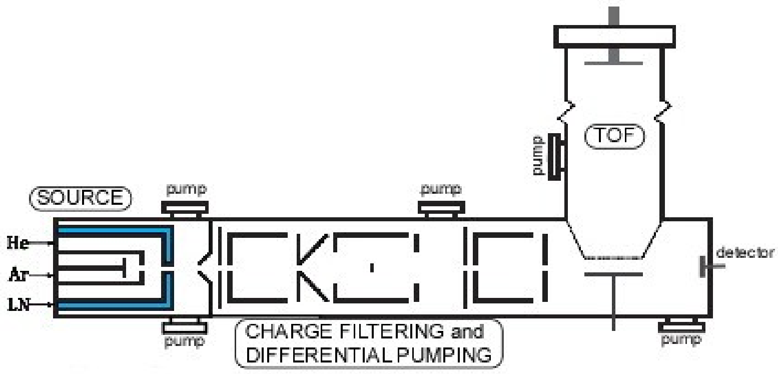
Abstract – An apparatus has been constructed for the production of small clusters of metals and metallic alloys. The production mechanism is based on the progressive aggregation of atoms due to collisions with an inert gas. Via an appropriate choice of the set-up parameters, it is possible to tune the average size of the particles in between 2 and several hundreds of atoms. We present here the main characteristics of the system and of the produced beam.

Clusters, i.e. nano-particles formed by a few tens of atoms only, attract great interest because of their peculiar properties as enhanced magnetic moment[1] and catalytic activity[2], size-specific fluorescence[3] and non-bulky geometrical structures. In order to understand the origin of these properties and to allow a careful comparison with theoretical models, it is necessary to precisely control the size, the composition and the energy of the clusters.

The apparatus presented here was projected, following the design of Haberland[5], to produce a beam of cluster ions with a tunable size distribution and a well defined energy. Those ions can then be deposited at low energy in UHV conditions on a substrate or in a matrix in order to perform *in-situ* and *ex-situ* experiments. A schematics of the apparatus is shown in the figure and described in the following.



A solid target is vaporized, using a planar or a cylindrical magnetron sputtering, into an aggregation chamber filled with an inert gas. Here the particles are formed via collisions and then extracted to an electrostatic guide that allows charge filtering and differential pumping. While the planar magnetron is already a standard tool in cluster physics[6], the use of a cylindrical design is an innovative idea that allows both the production of clusters of alloys and an increased efficiency in the number of produced particles.

Two techniques have been used in order to characterize the beam. Time of Flight mass spectrometry, performed extracting the particles perpendicularly to the beam direction and detecting them with a MCP detector after a 1m flight, allowed to determine the mass distribution, the purity and the composition in the case of alloys. Retarding Field Analysis was performed detecting the beam current with a Faraday cup after applying the retarding field with a grid, and allowed to determine the energy distribution of the clusters.

References

[1] I. Billas *et al.* Science **265** (1994) p.1682
[2] A. Sanchez *et al.* J.Phys.Chem. A **103** (1999) p.9573
[3] L. Peyser *et al.* Science **291** (2001) p.103
[4] H. Haberland *et al.* J.Vac.Sci.Technol. **12** (1994) p.2925
[5] M. Hillenkamp *et al.* Rev.Sci.Instrum. **77** (2006) p.25104