

Cluster size distributions of MeV particle induced desorption of frozen water targets described by coalescence growth

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Sinopse. Water ice thin films were bombarded by N beams with different incoming charge states and the desorbed ion yields were measured experimentally. The yield distributions were fitted using lognormal functions and analyzed using the coalescence growth model.

The fast atom bombardment of surfaces is an event of energy deposition that leads to the emission of photons, electrons, atoms and molecules from the solid. Water ice is well known for producing an abundant yield of molecular clusters when bombarded by energetic projectiles [1,2].

In this work, a thin layer of water ice is grown over a Cu substrate cooled by a liquid nitrogen cryostat.

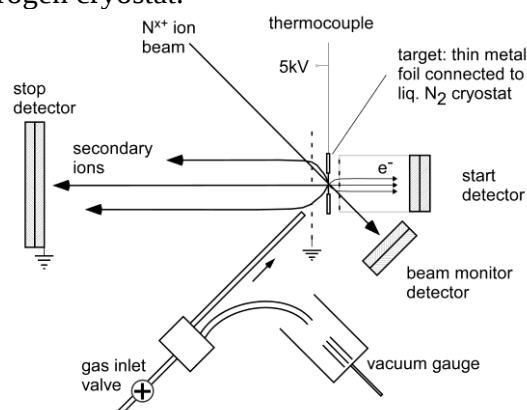


Figure 1. Scheme of experimental apparatus.

The target was then bombarded with N projectiles with 1700 keV energy and incoming charge states 2+, 3+, 4+, 5+ and 6+ at the Van de Graaff accelerator at PUC-Rio.

The use of projectiles with the same velocity in this work ensured that the energy deposited by the projectile in the ice layer is approximately distributed in cylindrical regions with the same radius of the infra and ultratrack. But the change in the incoming projectile charge state changes the amount of energy deposited in each track.

Fig. 2 show the ion yields of water clusters $(H_2O)_{n-1}H_3O^+$ induced by the different charge state of the incoming N beam. The data were normalized by the number of start events. It is seen that when the charge state increases the yield distribution moves towards lower values of n and the distribution gets broader. These

findings indicate that the increase in the energy deposited in each ion track for beams with higher charge states add more internal energy to the clusters.

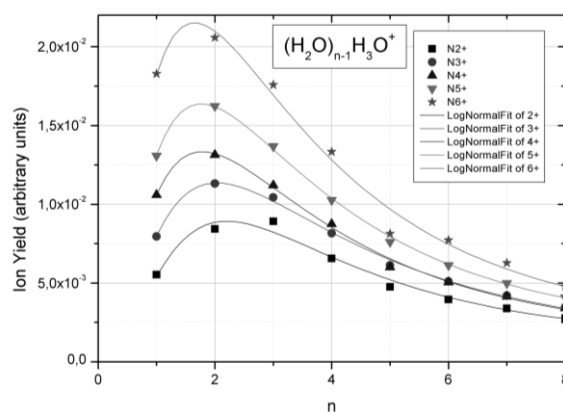


Figure 2. Points are measured ion yields of molecular clusters induced by N projectiles with different incoming charge states (from 2+ to 6+). Solid lines are fittings using a lognormal function.

The coalescence model of Villarica et al. [3] was used to analyze the data and according to its prediction the distribution observed for lower charge state projectiles (more negative “kernel homogeneity”) indicates a larger fractal dimension for the clusters. Clusters with larger fractal dimensions are less compact and have more sites available to add new molecules, increasing the mean cluster size.

References

- [1] Brown *et al.* 1982 *Nucl. Instrum. And Meth. B.* **198** 1
- [2] V. M. Collado *et al.* 2004 *Surf. Sci.* **569** 149
- [3] M. Villarica *et al.* 1993 *J. Chem. Phys.* **98** 4610

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