Early stages of water cluster growth observed with low-temperature scanning tunnelling microscopy

Signe Kyrkjebø,[1,2] Frederik Doktor S. Simonsen,[1] Richard Balog,[1,2] Liv Hornekær[1,2]

[1]*Center for Interstellar Catalysis and the Department of Physics and Astronomy*
[2]*Interdisciplinary Nanoscience Center*
Aarhus University, Denmark

Water ice is known to form on carbonaceous dust grains in the interstellar medium [1], but the structural morphology of icy grains including their chemical activity is still under investigation.

It has recently been shown that water molecules are mobile at temperatures down to 25 K on highly-oriented pyrolytic graphite (HOPG), suggesting that ice may grow via clustering rather than layer-by-layer [2]. However, realistic interstellar grains are not pristine and are likely terminated by various functional groups, which may further affect ice formation [3].

We have studied the initial stages of ice formation on HOPG and O-terminated HOPG, as dust grain analogues, using low-temperature scanning tunneling microscopy (LT-STM). Data reveal that step-edges and O-functional groups act as nucleation sites for ice formation. The size, fractal structure, and porosity of nanometer size water clusters are found to be strongly dependent on the sample temperature.

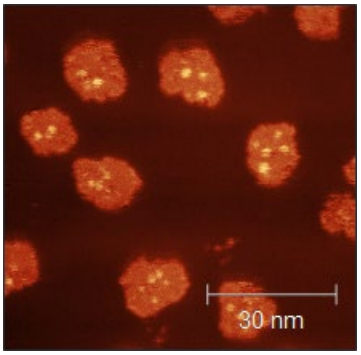

Figure 1: LT-STM image of water ice clusters on O-HOPG. It: 4 pA, Vt: 4.5 V.

References

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