Controlling water freezing on surfaces

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The existence of materials that catalyze the formation of ice on its surface has been known for decades. Nowadays we are able to obtain information at a molecular level of the structure of both the materials and the water films adsorbed on its surface when it is exposed to ambient conditions, where water is always present.[1] After the accumulation of studies on many materials there’s a consensus in the scientific community that some properties of the substrate, such as the mismatch between the surface lattice constant of the substrate, play a key role in determining the structure that water films would adopt when adsorbed on its surface. Many different inorganic materials are known to have such properties, for example AgI, some metals or BaF₂. Some of them are even able to induce ice-like structures on absorbed water even at room temperature [2]. Many organic molecules are also known to strongly affect water structures surrounding them and catalyze water freezing on the surface of their crystals or when adopting self-assembled monolayer (SAM) structures [3]. In our group we are now developing coatings based on SAMs technology that are able to determine the structure that water absorbed on its surface will adopt. These coatings are of great technological interest to explore the possibility of making coatings that induce the formation of ice crystals on substrates at temperatures close to 0°C. Such technology, once developed can be applied to snow making, rain seeding and reducing costs of ice making in the food industry.

Figure: AFM image of ice bilayers on BaF₂ (111) at 25°C.

References