Thin film forces during salt crystallization in confinement

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The devastating action of salts in monuments, artefacts and artworks is a major problem for their preservation. Damage due to salt is commonly attributed to the pressure that a growing crystal from a supersaturated solution exerts on its confining walls. We report experimental results obtained with an innovative setup which permits to visualize the spontaneous nucleation and growth during the evaporation of the salt solution while directly measuring the force exerted by a crystal during its growth in confinement. These experiments show the crucial role of wetting films between the growing crystal and the confining walls for the development of the pressure. Consequently, if the walls are made hydrophobic, no film and no crystallization pressure are detected. The results obtained for the growth of KCl and NaCl crystals between hydrophilic and hydrophobic glass walls suggests that the pressure originates from a repulsive electrostatic interaction between charged surfaces separated by thin liquid film. We also show that the magnitude of this pressure is consequently system-specific depending on the type of salt and the solid materials.

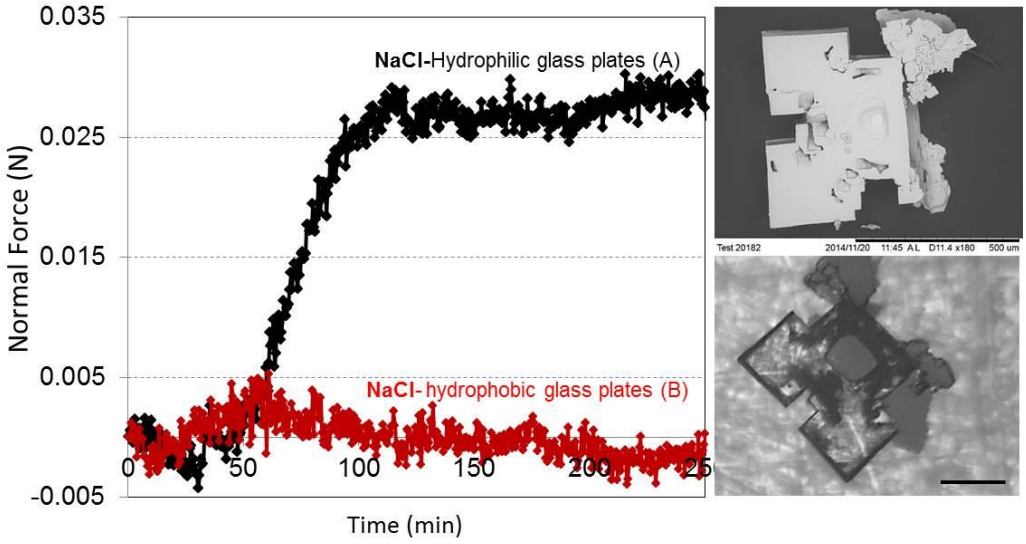

Figure 1. Detected repulsive force during the growth of NaCl crystal between hydrophilic (A) and silanized (B) glass plates,; Microscopic and SEM images of the NaCl crystal during the growth and at the end of experiments (A).