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Study of crystal growth with a Surface Forces Apparatus

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The measuring principle of SFA experiments is the optical multiple-beam interferometry that produces a series of colored fringes, known as fringes of equal chromatic order. This technique is commonly used to measure the separation between two surfaces (usually two transparent sheets of mica of identical thickness) interacting across a transparent medium (gas and liquid) and to determine the interaction (attractive or repulsive) force. One of our current projects concerns the study of confined electrolyte solution and crystal growth between mica surfaces and polymer-brush decorated surfaces. The high resolution of our eSFA (30 pm) allows measuring the dehydration of the ions during approach, which leads to a strong repulsive force. Preliminary results point at the existence of a layering of hydrated cations below separations of 8 nm and concentrations higher than 0.3 mM. The layering increases with concentration but above 30mM the attraction between ions and surface due to ion-correlations superposes to the repulsive hydration force and screens the dehydration steps. Solid-like (or crystal-like) behavior of the confined solution at small separations (<4 nm) is observed at concentrations below thermodynamic saturation in the reservoir solution. When a crystal grows in confinement between the mica surfaces, the growth pressure is sufficient to separate the surfaces from each other, demonstrating the action of the crystallization pressure.