THIN-FILM HYDRODYNAMICS IN ATOMIC FORCE MICROSCOPY

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Flow and drainage of thin liquid films play an important role in many industrial applications as well as in model processes, ranging from mineral processing and lubrication of micromechanical devices to oil drop coalescence and the stability of colloidal systems. Studies of liquid flow under confinement can reveal the limits of applicability of a classical hydrodynamics description, but are very challenging. Even though the first studies of drainage at nanoscale separation between atomically smooth mica sheets have been carried out using the Surface Force Apparatus (SFA) it is colloid probe Atomic Force Microscopy (AFM) that allows wider variety of confining solid surfaces to be studied.

AFM is the ideal tool for measuring both film drainage and surface forces. What is missing in a conventional AFM experiment is the possibility to measure independently the separation between interacting surfaces. For interactions between two hard objects, such as colloidal particles and flat solid surfaces, their absolute separation - which typically ranges from a few micrometres down to a few nanometres - can be determined easily by calibrating against the point of hard-wall contact. However, for soft and deformable surfaces, such contact may never occur, which makes the extraction of the absolute separation impossible. The lack of this crucial parameter in AFM experiments is a major obstacle for quantifying the surface forces in systems involving bubbles and droplets.
We have addressed the problem of the real nanoscale separation by incorporating an independent optical measurement of surface separation into the AFM instrument. This novel hybrid interferometry-AFM (*i*-AFM) technique enables an independent measurement of forces and separation between interacting surfaces such as bubbles or droplets. The results will be shown and discussed.