הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Special Seminar
Hall #6, Wolfson Department of Chemical Engineering,
Wednesday February 20th at 2:00pm

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Acoustic Stabilization and Enhanced de-Stabilization of Single Bubbles in Microfluidics

The manipulation of liquid films over a solid substrate, which support different forms of vibrations, have been investigated for over thirty years. It was recently found that oil and water may spread over a solid substrate that supports a propagating surface acoustic wave (SAW). Further theoretical and experimental studies showed the connection between acoustic spreading and the three-phase contact angle between the liquid, vapor, and solid substrate. Moreover, an important system in both industry and academia, which supports the formation of free liquid films, is the interaction between bubbles and solid substrates at close proximity. Examples of applications for the attachment of bubbles to solids are floatation unit operations, the intense purification of water, drag delivery and cancer treatment and microfluidics. We recently showed that the excitation of SAWs in a microfluidic channel might destabilize the micron thick film of liquid between a bubble and a solid substrate at close proximity, rendering attachment. Our results correlated very well with a model for the Landau–Levich type coating of a solid substrate by a liquid film under the action of a propagating MHz frequency SAW. We were able to show that the conditions that rendered the acoustic Landau–Levich coating film unstable in theory further supported the enhanced destabilization of the micron thick liquid film, which resulted in the fast attachment of the bubble to the substrate. Briefly, we show results for an acoustically stabilized film of water, which intermediates a quiescent bubble and the solid substrate of a 500-micron thick channel. We use monochromatic light microscopy to capture the spatiotemporal variations in the geometry of the micron thick film between the bubble and the substrate. The light diffracts in the liquid film, supporting the formation of light fringes of equal chromatic order (FECO) along the air/water interface. We convert the FECO to local variations in the film thickness and extract the dynamic film geometry under the influence of the SAW. We present new experimental results in which the conditions that render the acoustic Landau–Levich coating film stable in theory further supporting the stabilization of the micron liquid film between a bubble and a solid substrate. The film remains stable, resisting thinning, destabilization, and breakage, which will naturally occur in the absence of the SAW excitation.

Refreshments will be served at 1:45 pm