MECHANICAL ENGINEERING MSc SEMINAR (30 min.)

Thursday, August 18 2026 at 14:00 Israel time (19:00 China time)

Online: https://technion.zoom.us/j/93146493602?pwd=5CwUQduUaoohC5QEE5AXbOCNOUYchP.1

Lifetime-Dependent Multi-Hole Bursting of Oil-in-Water Emulsion Bubbles

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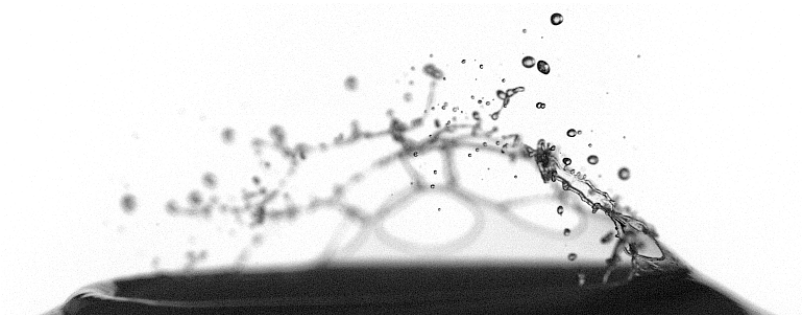
Bursting bubbles at contaminated air–water interfaces can aerosolize oil, microorganisms, microplastics, and other suspended contaminants. However, how dispersed oil droplets modify film drainage, rupture topology, and film-drop production remains unclear. This study investigates centimetric bubbles in purified water and dilute sunflower-seed-oil-in-water emulsions containing 0.05 and 0.5 vol% oil. Because bubble lifetime cannot be prescribed directly, it was measured for every event and used to condition the analysis. An automated experimental workflow was developed to obtain a large ensemble. A monitoring camera measured bubble lifetime and detected rupture onset in real time, automatically triggering high-speed imaging at 18,000 frames per second. High-magnification imaging was also used in selected experiments to resolve oil droplets within the bubble cap. More than 1000 complete bursting events were analyzed. The film thickness at rupture followed capillary–viscous drainage scaling and decreased with bubble lifetime with an exponent close to −2/3. At matched lifetimes, emulsion bubbles ruptured with systematically thicker films than purified-water bubbles, attributed to oil-induced Marangoni flow opposing drainage near the bubble foot. Increasing the oil fraction from 0.05 to 0.5 vol% raised the probability of multi-hole bursting from 2.3% to over 40% and increased the mean hole count from 2.2 to 11.8. Multi-hole events occurred mainly within an intermediate lifetime window of 4–9 s. Secondary holes formed shortly after the first rupture, producing multiple retracting rims that intensified rim–rim collisions, ligament formation, and film-drop production. A modified scaling law separated lifetime-dependent fragmentation from the geometric amplification caused by multiple holes. Preliminary measurements further indicate that oil-droplet enrichment in the bubble cap increases with bubble rise height, particularly in dilute emulsions. Ongoing work will examine whether this enrichment modifies multi-hole bursting.



Representative multi-hole bursting event in a 0.5 vol% sunflower-seed-oil emulsion

Seminars Coordinator: Prof. Sefi Givli

Note: the seminar will be given in English