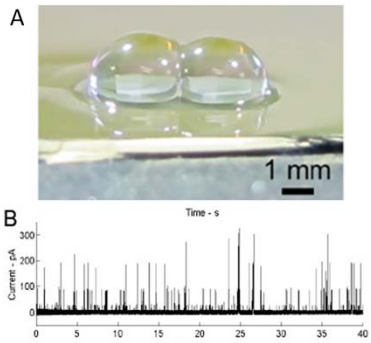
Air-Stable Droplet Interface Bilayers on Oil-Infused Surfaces



Pictured is a pair of water droplets that exhibit non-coalescence when in contact on an oil-infused nano-structured surface (A). The formation of air-stable droplet interface bilayers when phospholipids are added to the non-coalescing droplets. Ion channel transport was characterized by incorporating peptides into each droplet (B).

Scientific Achievement

We show that an air-stable droplet interface bilayer can form between non-coalescing water droplets on an oil-infused nanostructured surface.

Significance and Impact

This study is the first demonstration of nanoscale droplet interface bilayers in ambient environments, suggesting new avenues for the self-assembly of complex systems.

Research Details

- Water droplet-droplet interactions were characterized on an oil-infused surface consisting of superhydrophobic silicon nanopillars, fabricated using a lithography-free etching technique.
- The lifetimes of droplet non-coalescence was 1-3 orders of magnitude longer compared to droplets in contact in a submerged oil bath.
- When phospholipids were included in the non-coalescing water droplets, an air-stable droplet interface bilayer was formed that was used to detect single-channel gating events.

Work was performed at the Center for Nanophase Materials Sciences at ORNL.

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Narrative highlight text

Droplet interface bilayers (DIBs) are versatile model membranes useful for synthetic biology, biobatteries and biosensing; however, to date they have always been confined to fluid reservoirs. Here, we demonstrate that when two or more water droplets collide on an oil-infused substrate, they exhibit non-coalescence due to the formation of a thin oil film that gets squeezed between the droplets from the bottom-up. We show that when phospholipids are included in the water droplets, a stable droplet interface bilayer forms between the non-coalescing water droplets. As with traditional oil-submerged DIBs, we were able to characterize ion channel transport by incorporating peptides into each droplet. Our findings reveal that droplet interface bilayers can function in ambient environments, which could potentially enable the development of new classes of functional droplet networks.

Reference

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Jonathan B. Boreyko [a], Georgios Polizos [b], Panos G. Datskos [b], Stephen A. Sarles [c], C. Patrick Collier [a]
[a] Center for Nanophase Materials Sciences, ORNL, [b] Energy and Transportation Science Division, ORNL, [c] Department of Mechanical, Aerospace, and Biomedical

Engineering, The University of Tennessee, Knoxville, TN 37996

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