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How faceted liquid droplets grow tails: from surface topology to active motion[1]

ELI SLOUTSKIN, Physics Department and Institute of Nanotechnology Advanced Materials, Bar-Ilan University

Among all possible shapes of a volume V, a sphere has the smallest surface area A. Therefore, liquid droplets are spherical, minimizing their interfacial energy γA for a given interfacial tension $\gamma > 0$.
This talk will demonstrate that liquid oil (alkane) droplets in water, stabilized by a common surfactant can be temperature-tuned to adopt icosahedral and other faceted shapes, above the bulk melting temperature of the oil. Although emulsions have been studied for centuries no faceted liquid droplets have ever been reported. The formation of an icosahedral shape is attributed to the interplay between γ and the elastic properties of the interfacial monomolecular layer, which crystallizes here 10-15K above bulk melting, leaving the droplet's bulk liquid. The icosahedral symmetry is dictated by twelve five-fold topological defects, forming within the hexagonally-packed interfacial crystalline monolayer. Moreover, we demonstrate that upon further cooling this 'interfacial freezing effect makes γ transiently switch its sign, leading to a spontaneous splitting of droplets and an active growth of their surface area, reminiscent of the classical spontaneous emulsification, yet driven by completely different physics.
The observed phenomena allow deeper insights to be gained into the fundamentals of molecular elasticity and open new vitas for a wide range of novel nanotechnological applications, from self-assembly of complex shapes to new delivery strategies in bio-medicine.

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