Faceting of tailed liquid droplets: the role of topological defects

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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 γ. We demonstrate that liquid oil droplets in water, stabilized by a common surfactant, adopt icosahedral and other faceted shapes, tunable by temperature, while still remaining liquid[1,2]. Although liquid droplets have been studied for centuries, no faceted droplets have ever been detected.

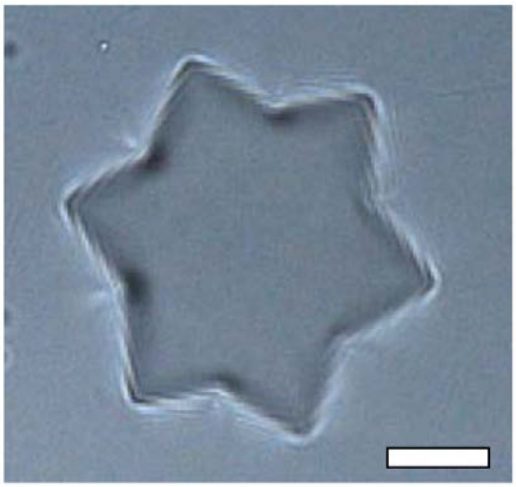

Figure: *An optical microscopy image of a droplet of oil in water, spontaneously adopting a hexagram platelet shape, while its bulk still remains liquid. The scale bar is 5μm.*

We attribute the observed transition from a spherical to an icosahedral shape to the interplay between γ and the elastic properties of the interfacial monomolecular layer, which in these systems crystallizes above the bulk melting point. The role of topological lattice defects in this quasi-two-dimensional crystalline surface monolayer will be discussed. The shape of the droplets is determined by the topological charge of these defects (i.e., the number of nearest neighbours missing at each defect), with the icosahedral droplets transforming on cooling into platelet-like rectangular, hexagonal, hexagram-like and other faceted shapes. In addition to faceting, we observe a wide range of other unexpected phenomena, such as a spontaneous splitting of liquid droplets. The common physical mechanism, responsible for all these effects will be demonstrated[1,2].

These phenomena allow deeper insights into the fundamentals of molecular elasticity to be gained, mimicking faceting transitions in complex biological systems and opening new horizons for a wide range of technologies, from self-assembly of complex colloidal shapes to new delivery strategies in bio-medicine.

[1] S. Guttman, Z. Sapir, M. Schultz, A. V. Butenko, B. M. Ocko, M. Deutsch, and E. Sloutskin, *Proc. Natl. Acad. Sci. USA* **113**, 493 (2016).

[2] S. Guttman, B. M. Ocko, M. Deutsch, and E. Sloutskin, *Curr. Opin. Colloid Interface Sci.* **22**, 35 (2016).