



Superspreading – Unraveling a >30 year old mystery

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Superspreading is an – also scientifically – fascinating phenomenon that was first observed more than 30 years ago [1] with dilute solutions of trisiloxane surfactants on hydrophobic substrates (Figure 1). Despite the work of many groups all over the world that have contributed significantly to the understanding of this phenomenon, the reasons why only some trisiloxane surfactants promote superspreading, whereas others of similar chemical structure behave more like ordinary surfactants, remained somewhat of a mystery for decades.

Equations and quantitative models that are in agreement with the kinetics of superspreading, but are not involving or even ignoring the chemical structure of the surfactants, cannot provide insight into the mode of action, i.e. an answer to the question how the superspreading surfactants are doing this (in contrast to the non-superspreading ones). One of the most frequently suspected driving forces is the Marangoni effect, but it is hard to believe why a surface tension gradient should persist for about 60 s, which is the typical timescale for superspreading. Therefore, a “better” hypothesis will be presented [3], which is A) in agreement with basic thermodynamics and B) able to explain all phenomena encountered in the application of trisiloxane surfactants, including the known structure/property relationships. Moreover, the proposed mode of action is in agreement with several experimental findings which are not related to wetting phenomena..

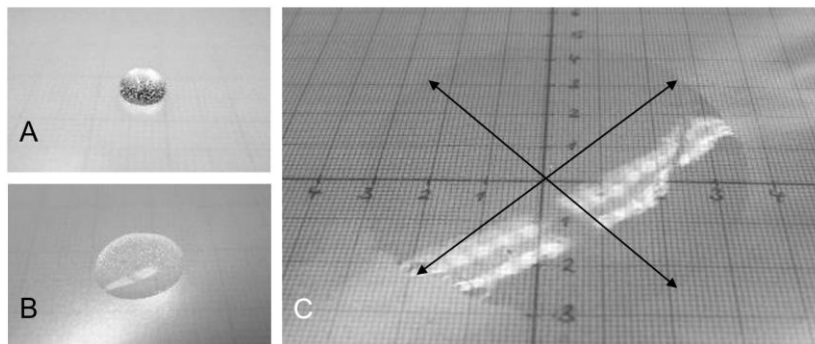


Figure 1. Photos taken 1 minute after placing a 50 μL droplet onto polypropylene film (with a cm scale underneath). (A) Water. (B) Non-superspreading trisiloxane surfactant ($\text{M}(\text{D}'\text{E}_{10}\text{P}_2\text{OH})\text{M}$): 15 mm diameter. (C) Superspreading trisiloxane surfactant ($\text{M}(\text{D}'\text{E}_6\text{P}_3\text{OH})\text{M}$): 70 mm diameter [2].

References

- [1] J. Venzmer, Superspreading – 20 years of physicochemical research, *Current Opinion in Colloid & Interface Science* **16** (2011) 335-343.
- [2] J. Venzmer, Superspreading, in “Droplet Wetting and Evaporation”, ed. D. Brutin, (Elsevier, 2015) 71-84.
- [3] J. Venzmer, Superspreading – Has the mystery been unraveled? *Advances in Colloid & Interface Science* **288** (2021) 102343.