Droplet passive movement on asymmetric patterned surfaces

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The study of the Morpho aega butterfly wings morphology[1] can be proven a valuable guide for the design of structured superrepellent surfaces. In particular, the asymmetric pattern of the surface protrusions facilitates the directional rolling of water droplets, rendering the surface easy-cleaning in moist environments. Here, the study of the geometric characteristics effect (e.g. corrugations shape, distance etc.) on the droplet repellency ability will offer design rules, useful for smart surfaces applications (e.g. self-cleaning solar panels and coatings). Furthermore, aiming to optimize the self-cleaning properties of a surface, inclined even at a small angle, a, (see Figure 1) the interplay of chemical inhomogeneities along with the complex topography is also examined.

We model the dynamic behavior of a droplet moving on geometrically pattered substrates by utilizing a recently proposed computational approach[2] which treats the entire droplet surface (both the liquid/vapor and liquid/solid interfaces) in a unified context. On the contrary to the conventional hydrodynamic models, in our computations the implementation of any boundary condition at the contact line is no longer required. Thus the stress singularity at any three phase contact line is alleviated, allowing modeling the droplet dynamics on complex geometries.

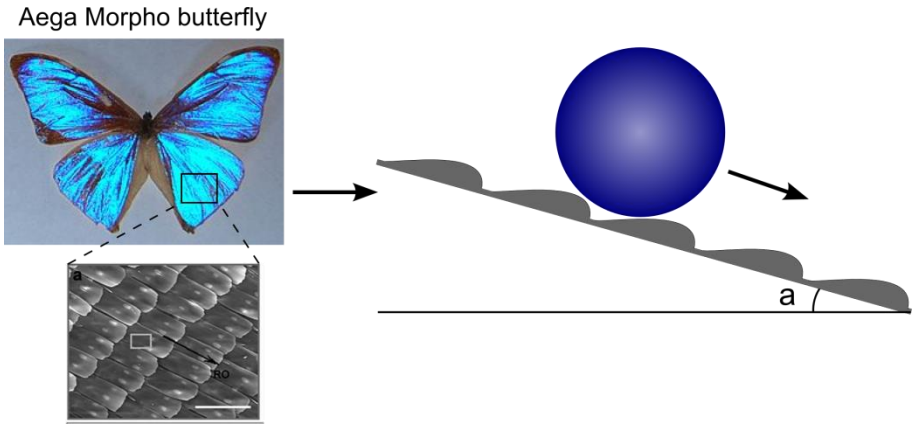

Figure 1 - Asymmetric structured surface, inspired from the butterfly wings morphology, facilitating the directional movement of a droplet.

References

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2. Chamakos, N. T., Kavousanakis, M. E., & Papathanasiou, A. G. (2013). Enabling efficient energy barrier computations of wetting transitions on geometrically patterned surfaces. *Soft Matter*, 9(40), 9624. doi:10.1039/c3sm51377g