Minicolloque 13 **Oral** **□ Poster**

Spontaneous spinning of a dichloromethane drop upon a CTAB solution

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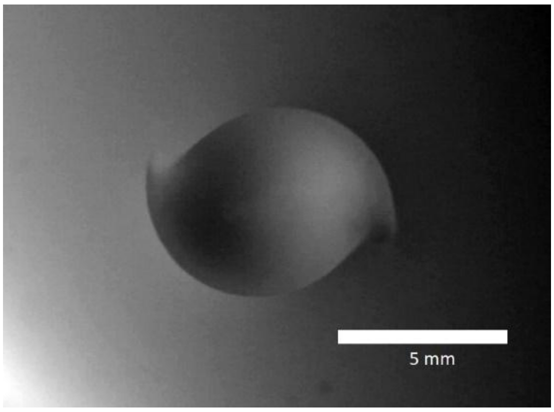
A dichloromethane drop released at a water surface spreads chaotically because of the surface tension gap between the two fluids. To stabilize its motion, we add some amount of CTAB, a cationic surfactant, to the water. As a result, the surface tension difference is lowered. Amazingly, beyond increasing the lifetime of the drop, the addition of CTAB yields diverse and complex dynamical behaviours of the system [1]. For instance, at 0.5 mM CTAB concentration, the drop pulsates repeatedly and draws a flower-like pattern at the surface [2].

An intriguing phenomenon arises around a 10 mM CTAB concentration. There, the drop evolves from an initial circular shape to a self-rotating system with a characteristic helix-like shape (left figure below). Thus a spontaneous symmetry breaking takes place, allowing a nonzero vertical torque to set in. The spinning lasts until the dichloromethane drop entirely dissolves and evaporates, which takes approximately 12s for a 20 microliter initial drop.

To study the system and elucidate the origin of the symmetry breaking, we observe the drop spinning with a Schlieren optical setup. This device allows us to determine the drop shape and measure the spinning velocity all along the run. Owing to the difference of the three surface tensions at the contact line, a radial Marangoni flow tends to move the water surface outward. This primary diverging flow combines with flows resulting from the high density (1.33) and volatility of the dichloromethane, resulting in a complex and composite pattern around the drop (right figure below). We determine the horizontal fluid velocity field around the drop at several distances from the surface by using two-dimensional PIV.

[1] Pimienta, Véronique, et al. "Complex shapes and dynamics of dissolving drops of dichloromethane." *Angewandte Chemie Int. Ed.* 50.45 10728-10731 (2011).
[2] Wodlei, Florian, et al. "Marangoni-driven flower-like patterning of an evaporating drop spreading on a liquid substrate." *Nature Communications* 9, 820 (2018).



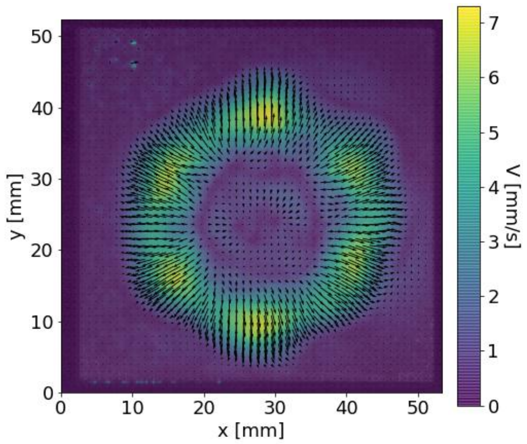


Figure 1 & 2 : (Left) Top view of a spinning dichloromethane drop at the surface of a 10 mM CTAB solution. (Right) Horizontal flow field around a drop within a plane located 2.5 mm below the surface.