PARTICLE MIGRATION IN INKJET-PRINTED DROPLETS

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The evaporation of sessile droplets can be a useful method to pattern substrates, with inkjet printing technology being particularly good at the selective deposition of functional materials. A predictive understanding of formulations is necessary in order to design systems in which the internal flows generated during drying do not lead to undesirable non-uniform morphologies.[1] Composition or temperature gradients across the liquid-vapour interface have been shown to induce Marangoni flows which can redistribute suspended material,[2] however studies have mainly taken place on microlitre droplets.

Here we report experiments on the internal flows of inkjet-printed picolitre droplets in which high-speed cameras are used to follow the trajectories of light-scattering tracer particles and record the droplet profile. Solutal Marangoni flows are generated in a selection of solvent mixtures and solutions however at these smaller length-scales different morphologies are observed. Instead of obtaining uniform deposits, particles are seen to migrate across flow streamlines[3] to collect in groups in ethanol-water mixtures, ethylene glycol-water mixtures and sucrose, lactose, sodium chloride and sodium nitrate solutions, demonstrating the prevalence of particle migration in a disparate range of chemical systems. A weak particle-size dependence to the migration is noted and a diffusiophoretic mechanism proposed.

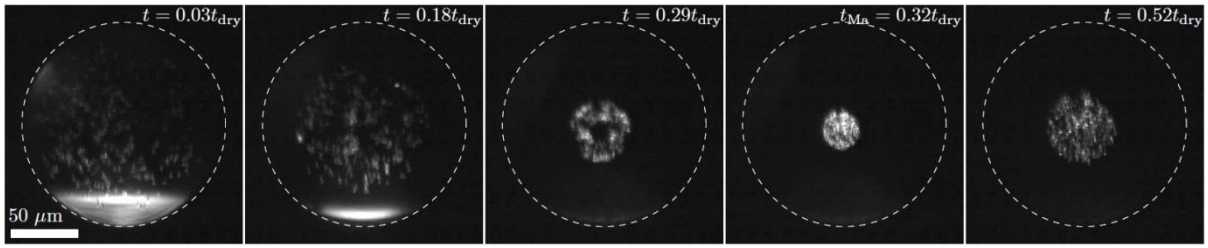

Figure 1. Particle migration towards the centre of an evaporating droplet of a 50:50%v ethanol-water mixture at *RH* = 50% on a cleaned glass coverslip. The dashed line is the position of the contact line. t_{Ma} is the time when the Marangoni flows ended and the collected group had its minimum radius while the overall drying time of the droplet was 2.4 s.

ACKNOWLEDGEMENTS: The authors acknowledge support from the Engineering and Physical Sciences Research Council under grant code EP/N025245/1.

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