

Watching Ink Dry

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'Watching paint dry' is a metaphor for a dull and pointless activity. One might think that 'watching ink dry' would conform to the same metaphor, but far from it. While the transport of particles to the contact line of a pinned drop – the coffee-ring effect – is well-known and well-understood, complex fluids (for example, those containing multiple phases, mixed solvents or surface-active agents or exhibiting non-Newtonian rheology) exhibit a rich variety of behaviour that often lacks a good theoretical basis. We are far from predicting the drying behaviour of complex fluids or from being able to design formulations to give a specific distribution and morphology in a dry deposit.

This talk will describe our efforts to measure, explain and control the drying of drops of the size used in inkjet printing i.e. a few tens of microns in diameters, or a few pL in volume. For volatile solvents, these drops dry in a few seconds or less, during which time internal flows may cycle multiple times. High-speed imaging is therefore used to track particle motion within a drying droplet. Topics to be discussed include Marangoni flows in mixed solvents [1], the use of sol-gel transitions to control deposit uniformity [2], particle migration [3], programmed aggregation of particles [4], and printing of emulsions.

1. "Drying and Deposition of Picolitre Droplets of Colloidal Suspensions in Binary Solvent Mixtures" Talbot, E.L.; Berson, A.; Bain, C. D. *NIP28: International Conference on Digital Printing Technologies and Digital Fabrication*, **2012**, 420–223.
2. "Control of Particle Distribution in Inkjet Printing through an Evaporation-Driven Sol–Gel Transition" Talbot, E. L.; Yang, L.; Berson, A.; Bain, C. D. *ACS Applied Materials and Interfaces* **2014**, *6*, 9572–9583.
3. "Internal Flows and Particle Transport Inside Picoliter Droplets of Binary Solvent Mixtures" Talbot, E. L.; Berson, A.; Yang, L.; Bain, C. D. *NIP29: International Conference on Digital Printing Technologies and Digital Fabrication*, **2013**, 307–312.
4. "Printing Small Dots from Large Drops" Talbot, E. L.; Yow, H. N.; Yang, Y.; Berson, A.; Biggs, S. R.; Bain, C. D. *ACS Advanced Materials and Interfaces*, **2015**, *7*, 3782–3790.