**Inkjet manufacturing: from droplets to films**

*Professor Colin Bain (Durham University) and Professor Andrew Bayly (University of Leeds).**To be hosted at Durham University*

The delivery of functional materials to surfaces via droplets is important in applications such as inkjet printing, spray coating and crop protection. Inkjet printing is moving beyond graphics applications to a manufacturing technology for displays, circuits and sensors, as well as being a technology for additive manufacturing. A large EPSRC collaborative grant with between Durham, Leeds, Bristol and 13 companies across six industrial sectors seeks to understand how to make functional particles and films from droplets either in free space or on surfaces. Recent examples include “In situ fabrication of polymeric microcapsules by ink-jet printing of emulsions” *ACS Applied Materials & Interfaces* (2019) *DOI*: [10.1021/acsami.9b14417](https://doi.org/10.1021/acsami.9b14417) and “A general ink formulation of 2D crystals for wafer-scale inkjet printing” *Science Advances* (2020) *DOI:*[10.1126/sciadv.aba5029](https://dx.doi.org/10.1126/sciadv.aba5029). The aim of this SOFI2 project is to extend our understanding of the drying of single droplets to multiple droplets and ultimately to film formation. Droplets can interact with each other through space or through the surface – miscible liquids may not coalesce and can chase each other across a surface. Understanding these interactions is essential to obtain uniform functional films with well-defined patterns. Placing different droplets beside (or on top) of each other offers opportunities for triggering physical or chemical changes e.g. phase changes or chemical interactions with the potential for the creation of structures that would not be achievable with a single ink.

It is envisaged that there will be three parts to the project:

(i) Understand how through space and through surface interactions affect the structure of films left by the drying of complex fluids, including polymers, particles or emulsions.

(ii) Explore how interactions between droplets of different fluids can be used to control the nature, shape or structure of patterns left behind as droplets dry.

(iii) Use the knowledge obtained from small numbers of drops in (i) to inform our design and understanding of practical printing and spraying processes involving very large numbers of drops.

The project will have a strong experimental component, but there are opportunities for interested students to develop theoretical or modelling approaches. There is scope, particularly in (ii), for a student to take the project in directions led by their imagination and curiosity.

The project will be based in Durham, drawing on the extensive experimental capabilities and support available. Theoretical and numerical aspects of the project will be primarily supported from Leeds, with the student located in Durham or Leeds.