MOLECULAR EVENTS KICK-OFF DROPLET COALESCENCE

Sreehari Perumanath[1], Matthew K. Borg[1], Mykyta V. Chubynsky[2], James E. Sprittles[2] and Jason M. Reese[1]

[1]School of Engineering, University of Edinburgh, Edinburgh EH9 3FB, UK; [2]Mathematics Institute, University of Warwick, Coventry CV4 7AL, UK

Sreehari.dharmapalan@ed.ac.uk

Ranging from the formation of thunderstorms in the atmosphere to the printers in our offices, droplet-based systems are ubiquitous in our everyday life. However, until now we have had only partial understanding of the mechanisms by which two or more droplets coalesce to form a larger droplet. The classical notion of coalescence of two droplets is that surface tension drives the process from the beginning. Using computationally expensive molecular simulations, here we show that thermal capillary waves on the droplet surface initiate single or multiple contacts between droplets and coalescence commences in a *thermal regime*. Here the bridges expand linearly in time due to collective molecular jumps near the bridge fronts. In this non-classical regime, surface tension acts to suppress the bridge growth. Transition to the classical hydrodynamic regime only occurs once the bridge radius exceeds a thermal length scale, and so this requires to be considered in hydrodynamic analyses of droplet coalescence.

ACKNOWLEDGEMENTS: The simulation results were obtained using ARCHER, the UK's national supercomputer. This research is supported by EPSRC grants EP/N016602/1, EP/P020887/1, EP/P031684/1, EP/R007438/1 and the Leverhulme Trust. JMR is supported by the Royal Academy of Engineering under the Chair in Emerging Technologies scheme.