Heterotypic coalescence of biological viscoelastic drops

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Collections of interacting biological units can self-organise into drops, constituting a form of entangled active matter. Biological drops are found across scales, from micron-sized biomolecular condensates or cellular aggregates to centimetre-sized ant colonies [1]. Entanglement allows these biological drops to flow like a fluid and spring back like an elastic solid. In the context of intracellular condensates, these structures usually self-assemble through the immiscibility of multiple droplet phases [2]. Despite multiphase droplet architecture is well understood for the case of liquid-like droplets, little is known about the role of elastic effects on their final configuration. Here, we extend the work in Ref. [3] to study the heterotypic fusion of two different viscoelastic drops by considering an interfacial surface tension between them. Inspired by the energy minimisation approach in Ref. [4] for heterotypic cell doublets, we derive the contact angle dynamics between the different interfaces of two viscoelastic drops through the minimisation of a Rayleighian function. Interestingly, we find that (1) elasticity prevents drop engulfment in a size-dependent manner and that (2) differential elasticity between the two drops can lead to engulfment even in the absence of interfacial tension. We envision drop coalescence as a high-throughput method to characterise the mechanics of soft biological materials.

References

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