Hydrodynamic cavitation in Stokes flow of anisotropic fluids

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Cavitation, the nucleation of vapour in liquids, is ubiquitous in fluid dynamics, and is often implicated in a myriad of industrial and biomedical applications. Although extensively studied in isotropic liquids, corresponding investigations in anisotropic liquids are largely lacking. We reveal flow-induced cavitation in liquid crystals at low Reynolds numbers [1]. We combine liquid crystal microfluidic experiments, nonequilibrium molecular dynamics simulations and theoretical arguments to identify the mechanism underpinning LC cavitation. The cavitation domain nucleates due to sudden pressure drop upon flow past a cylindrical obstacle within a microchannel. The inception and growth of the cavitation domain ensued in the Stokes regime, while no cavitation was observed in isotropic liquids flowing under similar hydrodynamic parameters. Using simulations we identify a critical value of the Reynolds number for cavitation inception that scales inversely with the order parameter of the fluid. Strikingly, the critical Reynolds number for anisotropic fluids can be 50% lower than that of isotropic fluids.

References

[1] T. Stieger, H. Agha, M. Schoen, M. G. Mazza, A. Sengupta, Nature Communications **8**, 15550 (2017).

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