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Microscale heat transfer enhancement using spinodal decomposition PIETRO POESIO, DAFNE MOLIN, Università di Brescia, via Branze 38, 25123 Brescia, Italy, NICOLAS G. HADJICONSTANTINOU, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139, USA, GIAN PAOLO BERETTA, Università di Brescia, via Branze 38, 25123 Brescia, Italy — In many cases, miniaturization is limited by our ability to quickly remove heat; current state-of-the-art cooling approaches have significant limitations, particularly for high heat flux applications. Recent studies have shown that phase separation of a binary liquid-liquid mixture quenched to a temperature below the spinodal curve can be used to enhance heat transfer in small-scale devices. In particular, it has been shown that the self propulsion of single droplets formed during the intermediate stage of spinodal decomposition can produce considerable agitation and, as a result, enhanced heat transport. Spinodal phase separation dynamics can be described by the coupled Cahn-Hilliard/Navier-Stokes equations; unfortunately, simulation of these equations at the device scale is computationally costly due to the mulltiscale nature of spinodal decomposition, which requires resolution of the phase interface between the two fluids which is of atomistic size. In this talk we discuss possible approaches for reducing this computational cost by calculating the resulting transport from synthetic fluctuating fields that simulate the effect of spinodal decomposition but are generated stochastically without solving the Cahn-Hilliard equation at close-to-atomistic resolution.

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