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Modeling thermocapillary flow on superhydrophobic surfaces TOBIAS BAIER, CLARISSA STEFFES, STEFFEN HARDT, Technische Universität Darmstadt — A liquid in Cassie-Baxter state confined between two microstructured superhydrophobic surfaces has a large free surface fraction while at the same time being in close contact to a solid. As such this configuration is predestined for thermocapillary transport when applying a temperature gradient along the structured substrate. We analytically and numerically investigate the thermocapillary flow over superhydrophobic arrays of fins, with the temperature gradient applied in parallel and transverse directions. At the gas-liquid interface Marangoni stresses exert a force on the liquid driving it towards the regions of higher surface tension. This leads to a spatially varying near-wall flow profile extending a distance of the order of the fin spacing into the liquid, while a plug flow prevails in the bulk of the liquid. In the Stokes limit we are able to relate the bulk flow velocity to the hydrodynamic slip length for pressure-driven flow over such surfaces. The numerical results indicate that this relation serves as an upper bound for the achievable flow velocities at large temperature gradients. Since even moderate temperature gradients of the order of a few K/cm can induce flow velocities of several mm/s for water-based systems, this setup lends itself for microfluidic pumping.

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