Abstract Submitted
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Three-dimensional simulations of surfactant-contaminated flows in superhydrophobic microchannels[1] SCOTT SMITH, FERNANDO TEMPRANO-COLETO, UCSB, FRANCOIS PEAUDECERF, ETH Zurich, JULIEN LANDEL, U. Manchester, FREDERIC GIBOU, PAOLO LUZZATTO-FEGIZ, UCSB — Trace amounts of surfactants are now known to severely limit the drag reduction along superhydrophobic surfaces, due to Marangoni stresses, as demonstrated in Peaudecerf et al. (PNAS, 2017), and Song et al. (PRF, 2018). When driving flow in superhydrophobic microchannels, surfactants adsorb onto the air-water interface (known as the plastron) and cause adverse Marangoni stresses in the opposite direction to the driving flow. There is currently an effective model that considers two-dimensional surfactant-laden flow in superhydrophobic channels (Landel et al. arXiv:1904.01194, 2019). Here we perform three-dimensional simulations of the full problem using COMSOL, in order to test our extension of this model to account for the drag of a fully three-dimensional flow. We are able to compute drag reduction as a function of the microchannel geometry, surfactant concentration, and the characteristic dimensionless numbers of the momentum and surfactant transport equations. These simulation results are then used to explore physical trends and validate our extended model.

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