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Effect of wall pattern configurations on Stokes flow through a microchannel with superhydrophobic slip H.M. MAK, C.O. NG — The present work aims to study low-Reynolds-number flow through a microchannel with superhydrophobic surfaces, which contain a periodic array of parallel ribs on the upper and lower walls. Mimicking impregnation, the liquid is allowed to penetrate the grooves between the ribs which are filled with an inviscid gas. The array of ribs and grooves gives a heterogeneous wall boundary condition to the channel flow, with partial-slip boundary condition on the solid surface and no-shear boundary condition on the liquid-gas interface. Using the method of eigenfunction expansions and domain decomposition, semi-analytical models are developed for four configurations. Two of them are for longitudinal flow and the others are for transverse flow. For each flow orientation, in-phase and out-phase alignments of ribs between the upper and lower walls are analyzed. The effect of the phase alignments of ribs is appreciable when the channel height is sufficiently small. In-phase alignment gives rise to a larger effective slip length in longitudinal flow. On the contrary, out-phase alignment will yield a larger effective slip length in transverse flow. This work was supported by the Research Grants Council of the Hong Kong Special Administrative Region, China, through Project HKU 7156/09E.

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