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Laminar flow drag reduction on a soft porous media surface[1]
ZHENXING WU, MICHAEL TAMBASCO, PARISA MIRBOD, Clarkson University — The ability to control flow reduction in microchannels could significantly advance microfluidic-based devices in a wide range of industrial applications including biomedical fields. The aim of this work is to understand the fundamental physics of the laminar skin friction coefficient and the related drag reduction due to the existence of porous media in the pressure-driven flow. We conducted an analytical framework to predict a laminar Newtonian fluid flow and corresponding drag reduction in a rectangular microchannel which coated with various soft random porous media. Specifically, we present predictions of the laminar skin friction coefficient, and drag reduction for pressure-driven flows. We found the laminar drag reduction is strongly depended on the Darcy permeability of porous medium, the thickness of the permeable layer, and the height of the microchannel. To verify the accuracy of our analytical predictions, several pressure-drop experiments were conducted. We chose various combinations of porous material and the morphology of the fibers to achieve a unique height ratio, between the height of two domains, and permeability parameter of porous media for each experiment. We found a good agreement between the experiments and analytical predictions of laminar drag reduction.

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