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Design and Fabrication of Membrane-Based Sensors for In-Situ Capillary Pressure Measurement in Microfluidic Channels NISHAGAR RAVENTHIRAN, RAZIN SAZZAD MOLLA, YAOFA LI, Montana State University, Bozeman — Pressure is a fundamental quantity in virtually all problems in fluid dynamics from macroscale to micro/nano-scale flows. Although technologies are well developed for its measurement at the macro-scale, pressure quantification at the microscale is still not trivial. Yet precise pressure mapping at the microscale such as in microfluidics is imperative in a variety of applications, including porous medium flows and biomedical engineering. In particular, pore-scale capillary pressure is a defining variable in multiphase flow in porous media and has rarely been directly measured. Herein we aim to design and fabricate an on-chip sensor that enables quantification of capillary pressure in microfluidic porous media, called micromodels. The micromodel is fabricated in PDMS using soft lithography with a thin membrane incorporated that deflects with pressure variations in the fluid flow. Employing a microscope coupled with a high-speed camera, 2D pressure fields can be inferred from membrane deflections based on a pre-calibrated relation, along with other flow parameters, such as velocity fields and phase distribution. This study provides a novel method for in-situ quantification of capillary pressure and a renewed understanding of pore-scale physics of multiphase flow in porous media.

Yaofa Li
Montana State University, Bozeman

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