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Microfluidic Bypass Manometry: Parallelized measurement of flow resistance of complex channel geometries and trapped droplets SIVA VANAPALLI, NAUREEN SUTERIA, MEHDI NEKOUEI, Department of Chemical Engineering, Texas Tech University — We report a technique referred to as "microfluidic bypass manometry" for measurement of pressure drop versus flow rate (ΔP-Q) relations in a parallelized manner. It involves introducing co-flowing laminar streams into a microfluidic network that contains a series of loops, where each loop contains a test geometry and a bypass channel as a flow rate sensing element. To demonstrate the technique, we measure ΔP-Q relations simultaneously for forty test geometries ranging from linear to contraction-expansion to serpentine to pillar-laden microchannels. The measured Newtonian flow resistance of these different geometries is in excellent agreement with CFD simulations. To expand the capabilities of the method, we measured ΔP-Q relations for similar-sized oil droplets trapped in microcavities where the cavity geometry spans from prisms of 3 – 10 sides to cylinders. We find in all cases, ΔP-Q relation is nonlinear and the flow resistance is sensitive to drop confinement and weakly dependent on cavity geometry. We anticipate that microfluidic bypass manometry may find broad application in several areas including design of lab-on-chip devices, laminar drag reduction, rheology of complex fluids and mechanics of deformable particles.

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