SIMO Microfluidic Device for Characterizing Hydrodynamic Slip

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In this paper, we have presented a microfluidic microfluidic device and its design specifications for a hydrodynamic slip characterization. The key feature of the device is a single-input-and-multiple-outputs (SIMO) system. The device contains two routes. The test fluid that enters the first route undergoes a series of step reductions of shear rate at a constant channel width; while the test fluid that enters the second route experiences a series of sudden expansion of channel width at a constant shear rate. The device also contains an on-chip switching valve that has fluid from the inlet port sent to either the first or the second route. Using this device, velocity profiles can be measured at various flow conditions such as shear rates and channel widths within a single run of an experiment. The chip is made of polydimethylsiloxane (PDMS) which is hydrophobic, and provides 6 different shear rates and 4 different channel widths for a given inlet flow rate. The velocity profile is obtained from the particle streak imaging by fluorescent microscope and the data processing method developed by ourselves. The slip length is calculated by linear extrapolation of the velocity profile near the channel wall.