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Programming fluid flow with microstructures HAMED AMINI, MAHDOKHT MASAELI, DINO DI CARLO, UCLA — Flow control and fluid interface manipulation in microfluidic platforms are of great importance in a variety of applications. Current approaches to manipulate fluids generally rely on complex designs, difficult-to-fabricate 3D platforms or use of active methods. Here we show that in the presence of simple cylindrical obstacles (i.e. pillars) in a microchannel, at moderate to high flow rates, streamlines tend to turn and stretch in a manner that, unlike intuition for Stokes flow, does not precisely reverse after passing the pillar. The asymmetric flow behavior up- and down-stream of the pillar due to fluid inertia manifests itself as a total deformation of the topology of streamlines that effectively creates a *net* secondary flow which resembles the recirculating Dean flow in curving channels. Confocal images were taken to investigate the secondary flow for a variety of microstructure settings. We also developed a numerical technique to map the fluid motion in the channel which is utilized to characterize the secondary flow as well as to engineer the fluid patterns within the channel. This passive method creates the possibility of exceptional control of the 3D structure of the fluid within a microfluidic platform which can significantly advance applications requiring fluid interface control (e.g. optofluidics), ultrafast mixing and solution control around cells.

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