Frictionless flows

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The hydrodynamic boundary condition of no-slip at solid walls of a tube limits achievable flow-rates and results in high pressure drop **[1]**. By stabilizing a fluidic channel within a ferrofluid we can replace the solid walls of conventional microfluidics with a liquid wall and provides the possibility to achieve near frictionless flows. We present an analytical model for the dynamics of flow suggesting large effective slip lengths which depend on the antitube radius and the viscosity ratio of the involved fluids **[2]**. This 'antitube' design **[3]** could be applied, for example, to room temperature flow accessories involved in cryogenic set ups **[4]**. When miniaturizing fluidic circuitry, the pressure drop Δp scales as d^{-4} for a channel of diameter d, making it challenging to pump liquids through ultra-small channels (~10 – 100 μm). In this context, we show experimentally how stabilized water micro-channels as small as 14 μm in diameter can be observed **[2],** opening new possibilities for microfluidics applications.

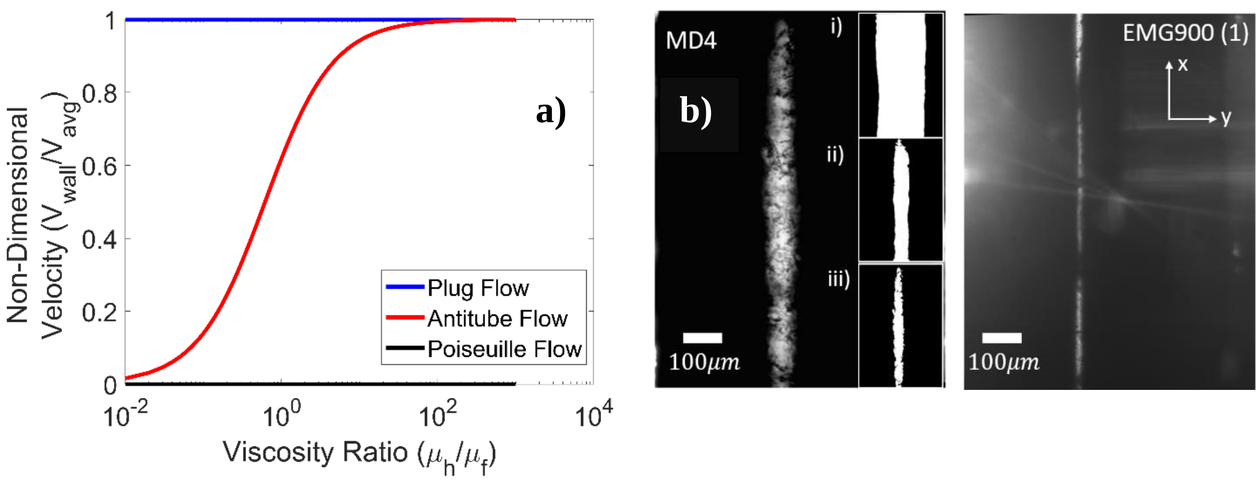

Fig. 1 a) Wall velocity as a function of viscosity ratio between the two immiscible liquids in contact. μ_h and μ_f are dynamic viscosities of flowing fluid and surrounding ferrofluid respectively. **b)** Water antitube (white) in a ferrofluid (black) environment. Smallest antitube in the rightmost figure is 14 μm. EMG900, MD4 are ferrofluids.

References

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