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Coating microchannels to improve Field-Flow Fractionation
TYLER N. SHENDRUK, GARY W. SLATER, University of Ottawa — We propose a selective-steric-mode Field-Flow Fractionation (ssFFF) technique for size separation of particles. Grafting a dense polymer brush onto the accumulation wall of a microchannel adds two novel effects to FFF: the particles must pay an entropic cost to enter the brush and the brush has a hydrodynamic thickness that shifts the no-slip condition. For small particles, the brush acts as a low-velocity region, leading to chromatographic-like retention. We present an analytical retention theory for small but finite-sized particles in a microchannel with a dense Alexander brush coating that possesses a well-defined hydrodynamic thickness. This theory is compared to a numerical solution for the retention ratio given by a flow approximated by the Brinkman equation and particle-brush interaction that is both osmotic and compressional. Large performance improvements are predicted in several regimes. Multi-Particle Collision simulations of the system assess the impact of factors neglected by the theory such as the dynamics of particle impingement on the brush subject to a flow.

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