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2D Flow patterning in Hele-Shaw configurations using Non-Uniform Electroosmotic Slip EVGENIY BOYKO, SHIMON RUBIN, AMIR GAT, MORAN BERCOVICI, Faculty of Mechanical Engineering, Technion - Israel Institute of Technology — We present an analytical study, validated by numerical simulations, of electroosmotic flow in a Hele-Shaw configuration with non-uniform zeta potential distribution. Applying the lubrication approximation and assuming thin electric double layer, we derive a pair of uncoupled Poisson equations for the pressure and the stream function, and show that the inhomogeneous parts in these equations are governed by gradients in zeta potential parallel and perpendicular to the applied electric field, respectively. We obtain a solution for the case of a disk with uniform zeta potential and show that the flow field created is an exact dipole, even in the immediate vicinity of the disk. We then illustrate the ability to generate complex flow fields using superposition of such disks. Furthermore, we study the inverse problem in which we define the desired flow pattern and solve for the zeta potential distribution required in order to establish it. We demonstrate that such inverse problem solutions can be used to create directional flows confined within narrow regions, without physical walls. We show that these solutions can be assembled to create complex microfluidic networks, composed of intersecting channels and turns, which are basic building blocks in microfluidic devices.

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