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Electrokinetics for control of on-chip chemical reactions. DAVID ERICKSON, California Institute of Technology, ROBERTO VENDITTI, XUEZHU LIU, ULRICH KRULL, DONGQING LI, University of Toronto — It is well known that electrokinetics affords precise control over flow and species transport in microfluidic systems through simple manipulation of externally applied electric potentials. In this work it is demonstrated how electrokinetic effects can be extended to provide simultaneous control over on-chip chemical reactions through manipulation of the local thermal (ohmic/joule heating), shear (electroosmosis) and electrical (electrophoresis) energies at the reaction site. The coupling of the electrical, flow and "whole-chip" thermal effects in both the fluidic and substrate domains are investigated through extensive finite element simulations and experimentally validated using microscale fluorescence thermometry. The simulations reveal changes in viscosity and local conductivity on the order of 50% induced by changes in the fluidic geometry. General chip design guidelines for maximizing or minimizing these effects will also be discussed. The degree of precision available and clinical utility of the technique is demonstrated through the detection of a single base pair mutation (single nucleotide polymorphism) in a DNA microarray integrated into a PDMS/glass microfluidic chip.

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