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Nonlinear Electroosmosis and Biomolecule Electrokinetic Trapping Induced by Ion Selective Nanofluidic Channels YING-CHIH WANG, Dept. of Mech. Eng., MIT, JONGYOON HAN, Bio. Eng. Division, Dept. of EECS, MIT — This paper describes a nanofluidic device that can concentrate dilute biomolecule by electrokinetic trapping mechanism. This device has nanofluidic channels with a depth down to 40 nm, therefore, having significant Debye layer overlap. Depending on the strength of the applied potential across the nanochannel, one can observe phenomena such as concentration polarization; charge depletion and nonlinear electrokinetic flow in the adjacent microfluidic channel using fluorescent microscopy. By manipulating the electric field, the device can generate an extended space charge region, maintained for several hours, within a microchannel as a mean to collect and trap biomolecules. Our studies demonstrate such device can achieve up to 10 million fold sample preconcentration within 30 minutes. Besides, if applied a higher potential, a much faster chaotic flow can be seen in the microchannel adjacent to nanochannels. This kind of nonlinear electrokinetic flow is often called the electroosmosis of the second kind or induced-charge electroosmosis in electrode and ion exchange membrane studies. The presented device can be used as either a preconcentrator or an injector to other separation and detection systems preferred its performance and integrabilty. Also, it is an ideal experimental platform for studying such nonlinear electrokinetic effects, by directly tracking molecules *in situ*.

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