Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Instability of electroosmotic channel flow with streamwise conductivity gradients JOSE SANTOS, BRIAN STOREY, Franklin W. Olin College of Engineering — This work considers the stability of an electroosmotic microchannel flow with streamwise electrical conductivity gradients, a configuration common in microfluidic applications such as field amplified sample stacking. Previous work on such flows has focused on how streamwise conductivity gradients set a non-uniform electroosmotic velocity which results in dispersion of the conductivity field. However, it has been known for many years that electric fields can couple with conductivity gradients to generate unstable flows. This work demonstrates that at high electric fields such an electrohydrodynamic instability arises and the basic mechanisms of this instability are explored through numerical simulations. The instability in this configuration is unique in that the non-uniform electroosmotic flow sets the shape of the underlying conductivity field in a way that makes it susceptible to instability. However, the instability is the direct result of electric body forces due to slight departure from electro-neutrality in the fluid bulk. A simple stability map is created where two dimensionless numbers can predict system stability reasonably well, even though the system formally depends on six dimensionless groups.

Brian Storey
Franklin W. Olin College of Engineering

Date submitted: 28 Jul 2008 Electronic form version 1.4