Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Bulk electroconvective instability at high Peclet numbers BRIAN STOREY, Franklin W. Olin College of Engineering, BORIS ZALTZMAN, ISAAK RUBINSTEIN, Ben-Gurion University of the Negev — Bulk electroconvection pertains to flow induced by the action of a mean electric field upon the residual space charge in the macroscopic regions of a locally quasi-electroneutral strong electrolyte. For a long time, controversy has existed in the literature as to whether quiescent electric conduction from such an electrolyte into a uniform charge selective solid, such as metal electrode or ion exchange membrane is stable with respect to bulk electroconvection. While it was recently claimed that bulk electroconvective instability could not occur, this claim pertained to an aqueous, low molecular weight electrolyte characterized by order unity electroconvection Peclet number. In this work we show that the bulk electroconvection model transforms into the leaky dielectric model in the limit of infinitely large Peclet number. For the leaky dielectric model, conduction of the above mentioned type is unstable, and so it is in the bulk electroconvection model for sufficiently large Peclet numbers. Such instability is sensitive to the ratio of the diffusivity of the cations to the anions. For infinite Peclet number, the case with equal ionic diffusivities is a bifurcation point separating stable and unstable regimes at low current limit. Further, when the Peclet number is finite and the anions are much more diffusive than the cations an unreported bulk electroconvective instability is possible at low current.

Brian Storey
Franklin W. Olin College of Engineering

Date submitted: 01 Aug 2007 Electronic form version 1.4