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Electrokinetic instability of isotachophoresis shocks GIANCARLO GARCIA, JUAN SANTIAGO, ALI MANI, Department of Mechanical Engineering, Stanford University — Isotachophoresis (ITP) is an electrokinetic focusing technique used in a variety of life science and analytical chemistry applications. In ITP, an electrokinetic shock wave forms at the interface between leading and trailing electrolytes with relatively high and low conductivities. The ITP interface is self-sharpening, as restoring electromigration fluxes counteract molecular diffusion. However, the large electric field gradient at the shock interface also gives rise to free charge and strong electrostatic body forces. At large applied currents, electrostatic forces cause recirculating flows which destabilize the ITP interface. We performed stability analysis and direct simulation of ITP shocks through numerical solutions to the coupled Nernst-Planck and Navier-Stokes equations using a quasi-electroneutral approximation. In both experiments and numerical simulations, we observe two modes of instability: 1) a distorted ITP interface which is steady in time, and 2) an oscillating perturbation which persists. In addition, at the highest simulated electric fields, we observe transition towards more chaotic oscillatory modes. We use our stability analysis and numerical simulations to characterize instability of ITP shocks using two dimensionless parameters.

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