

Abstract Submitted
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Overlimiting current and deionization shocks in porous media¹

MARTIN Z. BAZANT, DAOSHENG S. DENG, ALI MANI, E. VICTORIA DY-DEK, Department of Chemical Engineering, MIT — Salt transport in bulk electrolytes occurs by diffusion and convection, but in microfluidic devices and porous media, surface conduction and electro-osmotic flow also contribute to ionic fluxes. The classical theory of electrokinetic phenomena in porous media assumes linear response to a small voltage, where the electrolyte concentration is only weakly perturbed. When a large voltage or concentration gradient is imposed, some surprising nonlinear electrokinetic phenomena result from the competition between bulk and interfacial transport in a microstructure. At constant voltage, the microstructure can sustain an over-limiting current (exceeding diffusion limitation) without any hydrodynamic or chemical instability. At constant current, a “deionization shock” can propagate through the microstructure, leaving behind a macroscopic region depleted of ions and particles. This talk will present experimental evidence for surface-driven overlimiting current and deionization shocks in porous glass frits, interpreted with the help of mathematical models, and applications to water deionization by “shock electrodialysis.”

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