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Nonlinear I-V Characteristics of Nano-Pores: Depletion Layer Pattern Formation and Vortex Instability GILAD YOSSIFON, HSUEH-CHIA CHANG, University of Notre Dame — We report the first direct experimental proof for Rubinstein's instability [1] by using an applied AC electric field across a straight nano-slot, whose transverse dimension is at least 10 times larger than the depletion layer, EO convective flow is completely arrested and ion transport is dominated by diffusion and electro-migration. The ion flux dynamics is imaged using fluorescent dye molecules in combination with confocal microscopy, to understand the non-equilibrium phenomenon of over-limiting current density across a nanoporous membrane. With a slow AC field, an ion depletion front is generated intermittently from one end of the nano-slot and a vortex instability is found to arrest the self-similar diffusive front growth. This electrokinetic instability evolves into a stationary interfacial vortex array that specifies the over-limiting current, independent of external stirring or convective flow. [1] I. Rubinstein, E. Staude and O. Kedem, Desalination 69, 101 (1988).

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