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Dynamics of micro-vortices induced by ion concentration polarization in electrodialysis JOERI DE VALENCA, University of Twente & Wetsus, R.M. WAGTERVELD, Wetsus, ROB LAMMERTINK, PEICHUN AMY TSAI, University of Twente, SOFT MATTER, FLUIDICS AND INTERFACES GROUP, UNIVERSITY OF TWENTE TEAM, WETSUS TEAM — We experimentally investigate the coupled dynamics of global ion transport and local electroconvective flow of an electrolyte solution close to a charge selective membrane under an electric forcing. At small dc electric currents, due to the membrane permselectivity counterions (cations) transport diffusively through the cation exchange membrane (CEM) whereas the passage of co-ions (anions) is inhibited, thereby forming ion concentration polarization or gradients. At large currents, our simultaneous measurements of voltage drop and flow filed reveal several distinct dynamical regimes. Initially, the electrodialysis system exhibits a linear Ohmic electric resistance and then a rate-limiting regime with a voltage jump. Subsequently, electro-osmotic micro-vortices set in and grow linearly both in size and speed with time. After this linearly growing electroconvective regime, the measured voltage drop levels off around a fixed value. The average vortex size and speed saturate as well, however the individual vortices are unsteady and dynamical. Furthermore, the influence of micro-patterned CEM on the couple dynamics will be presented and discussed.

Peichun Amy Tsai
Soft matter, Fluidics and Interfaces, University of Twente

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