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Field-enhanced electrokinetic charge separation induced by thermocapillarity-driven flow in a liquid film MATHIAS DIETZEL, STEFFEN HARDT, Institute of Nano- & Microfluidics, Center of Smart Interfaces, TU Darmstadt — Thermocapillary stresses acting tangentially to the interface of a thin liquid film in a wide slot subjected to a lateral thermal gradient induce a rotational flow pattern. We demonstrate analytically and numerically for an electrolyte as working fluid that this flow can be used to separate charges and induce a streaming potential based on the electrokinetic effect, converting thermal to electric energy. The charge separation efficiency is commonly spoiled by the circumstance that the excess ions accumulate in direct vicinity of the wall where frictional losses are highest. As an alternative, we impose a traverse electric field across the film so that excess ions also accumulate at the gas-liquid interface where the highest flow velocities occur. No power is needed to maintain the external field if the deformation of the interface remains negligibly small, requiring in turn sufficiently small applied thermal and electric gradients below critical values of hydrodynamic and electrostatic instabilities. We estimate the increase and the upper limit of the streaming potential as well as of the overall conversion efficiency as a function of the applied voltage and the film thickness scaled to the Debye length.

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