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Electrokinetic flows through a parallel-plate channel with slipping stripes on walls[1] HENRY C.W. CHU, CHIU-ON NG, Department of Mechanical Engineering, The University of Hong Kong — Electrohydrodynamic flows through a periodically-micropatterned plane channel are considered. One unit of wall pattern consists of a slipping and non-slipping stripe, each with a distinct zeta potential. The problems are solved semi-analytically by eigenfunction expansion and point collocation. In the regime of linear response, the Onsager relation for the fluid and current fluxes are deduced as linear functions of the hydrodynamic and electric forcings. The phenomenological coefficients are explicitly expressed as functions of the channel height, the Debye parameter, the slipping area fraction of the wall, the intrinsic slip length, and the zeta potentials. We generalize the theoretical limits made in previous studies on electrokinetic flow over an inhomogeneously slipping surface. One should be cautious when applying these limits. First, when a surface is not 100% uniformly slipping but has a small fraction of area being covered by no-slip slots, the electroosmotic enhancement can be appreciably reduced. Second, when the electric double layer is only moderately thin, slipping–uncharged regions on a surface will have finite inhibition effect on the electroosmotic flow.

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Henry Chi Wah Chu
Department of Mechanical Engineering, The University of Hong Kong

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