Electroosmotic flow of a power-law fluid in a non-uniform microchannel

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An analytical model is presented for electrokinetic flow of a power-law fluid through a slit channel with gradually varying channel height and wall potential. With the near-wall depletion effect taken into account, the present model is based on the lubrication approximation and the use of the Helmholtz–Smoluchowski slip boundary condition. It is found that interaction between the wall undulation and the wall potential modulation, under the combined action of hydrodynamic and electric forcings, may give rise to a rich set of nonlinear behaviors for flow of a non-Newtonian fluid in the channel. In particular, the linear superposition of flow components due separately to the two forcings is found to work only for a strictly uniform channel; non-uniformity in channel height or wall potential distribution will spoil such linearity.

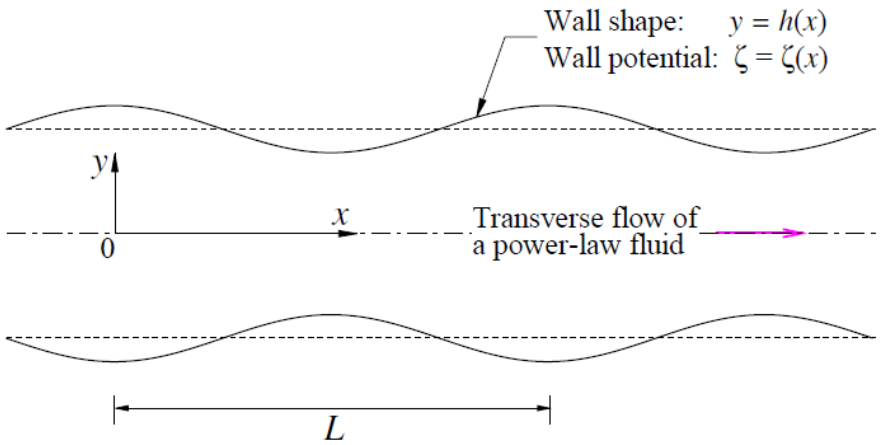

Figure 1. Transverse pressure-driven and electroosmotic flow of a power-law fluid through a slit channel with undulated walls and charge-modulated surfaces.

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