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Transition Thresholds in Microchannels under the EDL Effect

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We have recently shown that the electric double layer destabilizes considerably the micro-channel flows. Thus, the critical Reynolds number may decrease by a factor of 10 under the EDL effect and some circumstances. Due to the subcritical nature of the instability, both the non linear saturation of the primary stability and formation of a secondary flow, together with the secondary instability processes have to be analyzed in EDL flow similarly to the Poiseuille macro-flow. The analyze of the EDL effect on the nonlinear stability mechanism is performed through the spatio-temporal development of a spot in a channel flow by Direct Numerical Simulations in this investigation. A perturbation related to a pair of counter rotating vortices is followed in time and space with and without EDL. Results show the profound destabilizing EDL effect providing that the liquid contains a very small amount of ions with large enough Zeta potential and low conductivity/viscosity.

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