Time delay and fluid slippage in time-periodic electrokinetic microfluidic flows

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To study the unsteady pressure-driven microchannel flows, two different forms of sinusoidal pressure gradients are imposed to an electrolyte solution flowing through a hydrophobic microchannel with a rectangular cross-section. In this research, we have concentrated on testing the time delay and the fluid slippage influenced by three representative factors: frequency of the pulsating pressure, thickness of electric double layer (EDL) formed on the channel wall, and the slip length that measures the hydrophobicity of the channel. The introduction of pulsating pressure gives rise to a small time delay between pressure and velocity profile. The delay is getting longer as frequency is being increased. On the contrary, the increasing frequency reduces the fluid slippage. The electroviscous effect of the EDL is also observed: the slower velocity at the surface of wall is achieved with thick double layer. The magnitudes of the effects of frequency and EDL on the fluid slippage are very similar to each other in the given conditions.