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Nonlinear concentration waves in current monitoring method for measurement of electroosmotic flow MOHAMMAD BABAR, KAUSHLENDRA DUBEY, SUPREET SINGH BAHGA, Department of Mechanical Engineering, Indian Institute of Technology Delhi — Current monitoring method for measurement of electroosmotic flow (EOF) in a microchannel involves displacement of a binary electrolyte initially filled in the channel by a similar electrolyte but having a different conductivity, under the effect of electric field. A fixed voltage is applied across the channel ends and the temporal change in current is measured. Because a conductivity gradient in a binary electrolyte migrates only due to EOF and not due to electromigration, the time taken by one electrolyte to displace another gives an estimate of EOF. This displacement time is usually independent of whether a high-conductivity electrolyte displaces a low-conductivity electrolyte or vice versa. However, few studies have reported that, for low-conductivity electrolytes, the displacement time depends on whether the displacing electrolyte has higher or lower conductivity than the displaced electrolyte. In this study, we show that this directional dependence of displacement time is a result nonlinear concentration waves, such as shock and rarefaction waves, that form when surface conduction is comparable with bulk conduction. We present analytical expressions for current-time relationship in this regime and validate them with experimental observations.

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