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Interplay of induced charge electroosmosis, electrothermal flow, and dielectrophoresis at insulating constrictions NAGA NEEHAR DINGARI, QIANRU WANG, CULLEN BUIE, Massachusetts Inst of Tech-MIT — We present a theoretical and experimental study on the combined influence of induced charge electroosmotic flow (ICEO) and electrothermal flow on particle motion in an insulator based dielectrophoretic (iDEP) device. Strong electric fields used for particle trapping induce charges on the channel wall of low, but finite permittivity [1], and also induce strong temperature gradients [2] because of Joule heating. Consequently, the background fluid flow near the constriction is a superposition of these two effects. Our analysis presents a hitherto unexplored interplay between these two effects and how they influence particles which also experience dielectrophoresis. From our analysis, we find that for channels of low surface permittivity and conductivity, electrothermal effects are stronger near the constriction compared to ICEO effects, while the opposite is true when the surface permittivity or conductivity (or both) are comparable to that of bulk fluid. The analysis also includes the pH and electrolyte concentration dependent contributions of the dynamic Stern layer on ICEO flow.

[1] Zhao, C.; Yang, C. AC Field Induced-Charge Electroosmosis over Leaky Dielectric Blocks Embedded in a Microchannel. Electrophoresis 2011, 32, 629–637.
[2] Hawkins, B. G.; Kirby, B. J. Electrothermal Flow Effects in Insulating (electrodeless) Dielectrophoresis Systems. Electrophoresis 2010, 31, 3622–3633.

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