Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Modeling Microscale Electro-thermally Induced Vortex Flows
RAJORSHI PAUL, TIAN TANG, University of Alberta, ALOKE KUMAR, Indian Institute of Science — In presence of a high frequency alternating electric field and a laser induced heat source, vortex flows are generated inside micro-channels. Such electro-thermally influenced micro-vortices can be used for manipulating nanoparticles, programming colloidal assemblies, trapping biological cells as well as for fabricating designed bacterial biofilms. In this study, a theoretical model is developed for microscale electro-thermally induced vortex flows with multiple heat sources. Semi-analytical solutions are obtained, using Hankel transformation and linear superposition, for the temperature, pressure and velocity fields. The effect of material properties such as electrical and thermal conductivities, as well as experimental parameters such as the frequency and strength of the alternating electric field, and the intensity and heating profile of the laser source, are systematically investigated. Resolution for a pair of laser sources is determined by analyzing the strength of the micro-vortices under the influence of two heating sources. Results from this work will provide useful insights into the design of efficient optical tweezers and Rapid Electrokinetic Patterning techniques.

Rajorshi Paul
University of Alberta

Date submitted: 14 Jul 2017 Electronic form version 1.4