Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Reaction Kinetics in Micro/Nanofluidic Devices: Effect of Confinement and AC Voltage VISHAL V.R. NANDIGANA, NARAYANA R. ALURU, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign — Owing to limited sample consumption, electrokinetic control of convective transport and rapid dissipation of heat, nanofluidic devices are currently being investigated extensively in the field of chemical reactions. The reactants are typically transported into the nanochannel by using external DC electric fields. In this study, a novel technique to increase the rate of catalytic reactions inside nanofluidic devices is presented. Specifically, the effect of combined AC and DC electric fields on different reaction kinetics was numerically investigated and it was found to enhance the rate of formation of desired species in reaction limited kinetics (when the Damköhler number (Da) ≤ 1). We investigate the role of AC frequency, amplitude, channel height and surface charge density on reaction kinetics. We develop analytical expressions for fluid transport under combined AC and DC fields and also develop expressions to identify optimal frequencies. Several examples are considered to illustrate the effect of AC fields on chemical reactions in nanochannels.

Vishal V. R. Nandigana
Mechanical Engineering, UIUC, IL - 61801.

Date submitted: 07 Aug 2010 Electronic form version 1.4