Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Secondary flow effect on electrokinetic transport in curved channels and microfluidic mixing MYUNG-SUK CHUN, JIN-MYEONG LIM, Korea Institute of Science and Technology (KIST) — This presentation reports the numerical framework and important new results regarding the velocity pattern, vorticity, and mixing property, with variations of channel geometry and heterogeneity of surface properties. Extending our previous studies, secondary Dean flow in curved rectangular microchannels is examined by applying the finite volume/SIMPLE algorithm for the pressure-driven electrokinetic transport coupled with the Poisson-Boltzmann/Navier-Stokes/Nernst-Planck equations. Hydrophilic glass and hydrophobic polymers with fluid slip are combined to create different channel configurations with ranging complementary aspect ratios. Simulation results show that, contrary to the case of narrow-bore channels, the streamwise axial velocity tends to shift toward the inner wall caused by a stronger effect of the spanwise pressure gradient. We observe the presence of pairs of counter-rotating vortices perpendicular to the flow direction and evaluate the circulation magnitude. The increasing rate of inner shift with increasing curvature ratio is more significant in the shallow channel, and the patterns of axial velocity and vorticity alter by the heterogeneity effect of surfaces occupying a large area. In addition, the inertial force should be considered for precise control of the micro- or nanoflows.

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Date submitted: 24 Jul 2010 Electronic form version 1.4