Electrohydrodynamics in Polyelectrolyte Layer Grafted Narrow-Fluidic Channels

Narrow-fluidic channels with built-in polyelectrolyte layers (also called the soft layers) at the inner walls are widely used to transport bio-samples in on-chip applications. The grafted polyelectrolyte layer (PEL) demonstrates its profound efficacy in application-driven micro/nanofluidics. Unresolved issues on the underlying transport in PEL grafted narrow fluidic pathways are not only restricted to the transport of Newtonian fluids but also include the analysis of non-Newtonian fluids as well. In the present study, some of the pertinent issues are investigated. These include electroosmotic transport of non-Newtonian biofluids in PEL grafted narrow fluidic confinement, electroosmotic mixing in narrow-fluidic assay having walls grafted with patterned PEL, the Coriolis force induced micromixing in the soft narrow-fluidic channel, and the enhancement of electro-chemo-mechanical energy conversion in the narrow-fluidic batteries. The inferences obtained from these studies suggest that the complex interplay between the soft layer modulated rich interfacial electrochemistry and the non-Newtonian fluid rheology leads to the enhancement in the net throughput of bio-fluids. Such intricate dynamics, particularly for viscoelastic fluid transport through a narrow channel, contribute to the giant enhancement of the energy conversion efficiency. Besides, the stronger electroosmotic flow obtained due to the grafted PEL enhances the mixing performance in the rotating soft channels, and the channels having the walls grafted with the patterned PEL.