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Application of Nonlinear Electrokinetic Transport using Network Heterogeneity of Porous Media[1] HYEKYUNG LEE, Seoul National University, ALI MANI, Stanford University, SUNG JAE KIM, Seoul National University
— Nanoscale electrokinetic transport through perm-selective membranes has been actively researched using a micro/nanofluidic platform recently. The ion depletion layer formed near the membrane under dc bias can be compartmentalized using heterogeneous microchannels and a numerical/experimental study using the simplified porous media demonstrated an internal recirculation flow due to different hydraulic resistance in network of channels. Furthermore, overlimiting current significantly increased due to this flow so that the channel with the higher resistance played as the main current path. In this presentation, we applied this mechanism to practical engineering problems. First, we investigated electrokinetics by laying a permselective membrane on only the main current path. By comparing the devices either with uniformly patterned membrane vs non-uniformly patterned membrane (i.e. membrane only at the current paths), a similar perm-selective ion transportation was measured, leading to the same mass transfer but the half of membrane material cost. Second, it is expected that network effect could localize the membrane fouling because the mass transfer is dominant through the main current path.

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