Energy, Environment and Sustainability Laboratory

Professor Sung Jae Kim (gates@snu.ac.kr)
http://ees.snu.ac.kr
Department of Electrical and Computer Engineering

Abstract

- 2012 ~ Assistant, Associate Professor, SNU
- 2015 Co-founder of WiseWater Co. Ltd.
- 2005 ~ 2012 Research Associate, MIT
- 2005 Ph. D. of MechE/ChemE, POSTECH
- 2000 M. S. of ChemE, POSTECH
- 1998 B. S. of ChemE, POSTECH

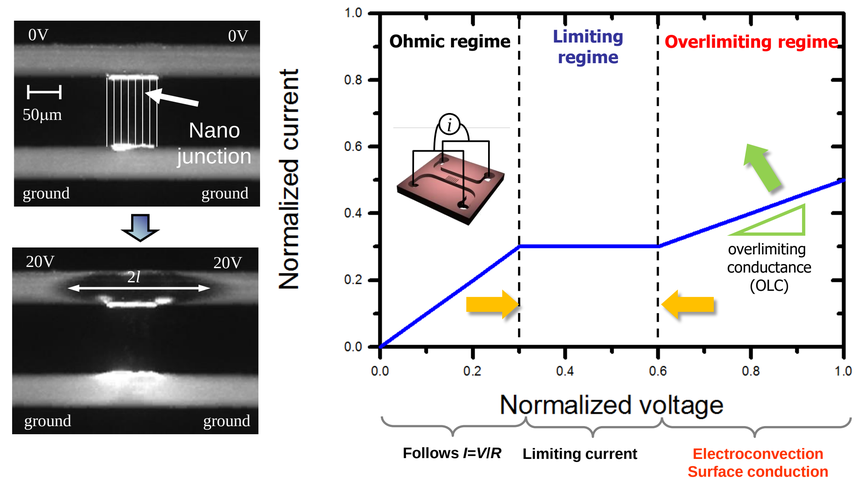
EES laboratory has researched about the **new fundamental nanoscale electrokinetic theory** of ICP involving the dynamic changes of concentration / electric field / fluid flow and developed **novel engineering applications** such as a liquid state semiconductor, a portable purification system, high energy efficient electrochemical membrane system and (bio)-molecular preconcentration devices.

Selected Publications

- ***Nano Letters***, 18, 2018, pp 7642-7650
- ***Biosensors and Bioelectronics***, 107, 2018, pp103-110
- ***Angewandte Chemie International Edition***, 56, 2017, pp795-800
- ***Physical Review Letters***, 116, 2016, p254501
- ***Nature Communications***, 7, 2016, p11223
- ***Physical Review Letters***, 114, 2015, p114501
- ***ACS Nano***, *7*, 2013, p740
- ***Journal of the American Chemical Society***, *133*, 2011, p10368
- ***Nature Nanotechnology***, *5*, 2010, p297
- ***Nano Letters***, *10*(1), 2010, p16
- ***Chemical Society Reviews***, *39*(3), 2010, p912
- ***Physical Review Letters***, *99*(4), 2007, p044501

Ion Concentration Polarization

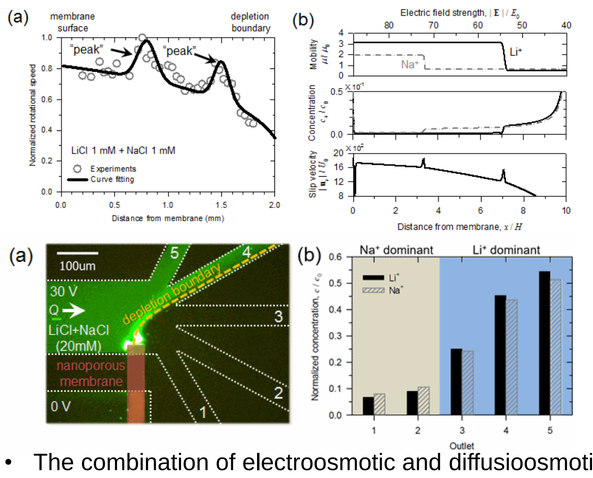
Ion Transport through Membrane



Physical Review Letters *99*, p044501, 2007

Fundamentals of Nanoscale Electrokinetics

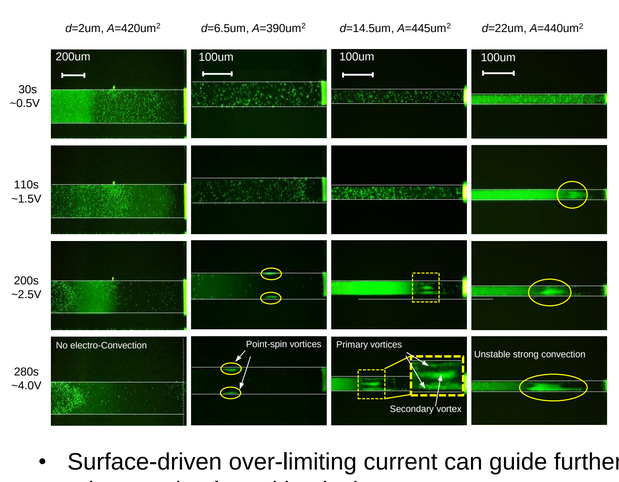
Non-Negligible Diffusio-osmosis



- The combination of electroosmotic and diffusioosmotic slip velocity had a form of an anomalous non-monotonic function

Physical Review Letters *116*, 254501, 2016

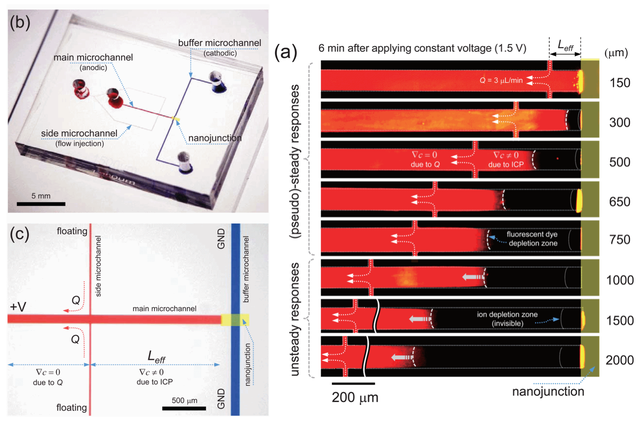
Verification of Overlimiting Current



- Surface-driven over-limiting current can guide further advances in electrokinetic theory

Physical Review Letters *114*, 114501, 2015

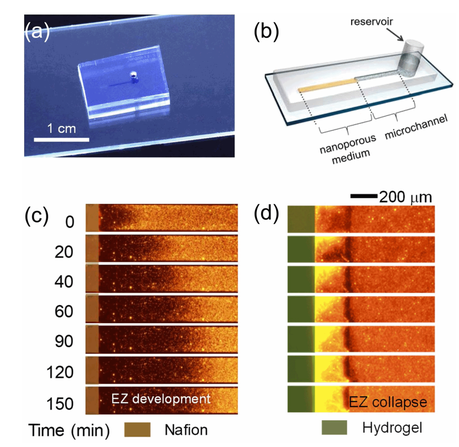
Eliminated overshoot current



- Overshoot current eliminated by limiting the length of the diffuse layer using a coercive injection of a fresh electrolyte solution

Biomicrofluidics *14*, 014106, 2020

Non-negligible Water-permeance

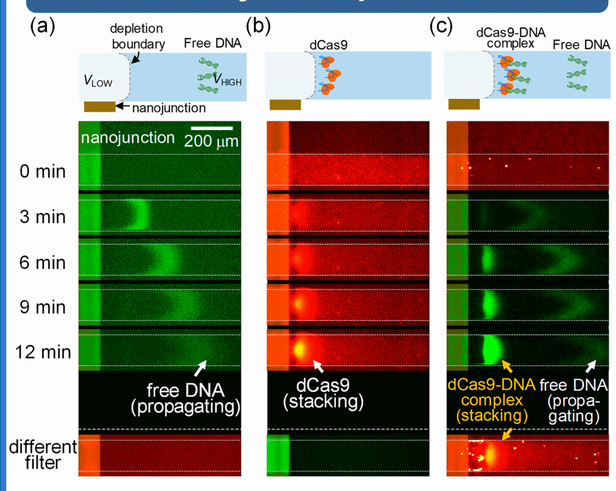


- Non-negligible water-permeance would be a substantial fundamental of transport phenomena at the interface of the ion exchange medium and electrolyte

Scientific Reports *8*, 12842, 2018

Active Ion Control for Bio & Energy Applications

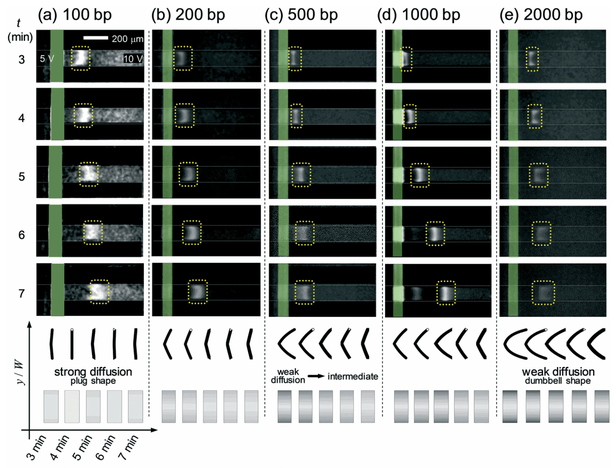
Critical mobility-based preconcentration



- Through the modulation of the critical mobility to shift those behaviors, CCR5 sequences were optically detected without PCR amplification

Nano Letters *18*, 7642-7650, 2018

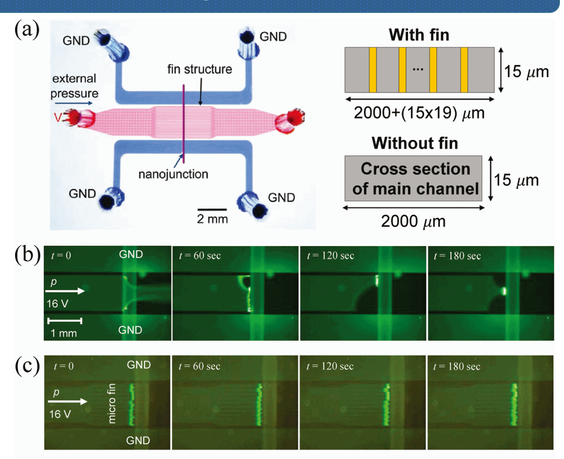
Driftless preconcentration



- Anomalous shapes of preconcentrated analytes and the morphologies were analytically modeled by the leverage of convection and diffusion migration

Lab on a Chip *19*, 3190-3199, 2019

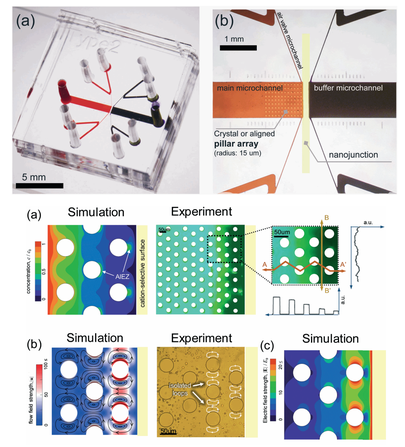
Stabilization by compartmentalization



- Micro fin structures inside a ICP device demonstrated a stable formation of ICP layer and its performance for high throughput

Nanoscale *9*, 3466-3475, 2017

Stabilization by dielectric microstructures

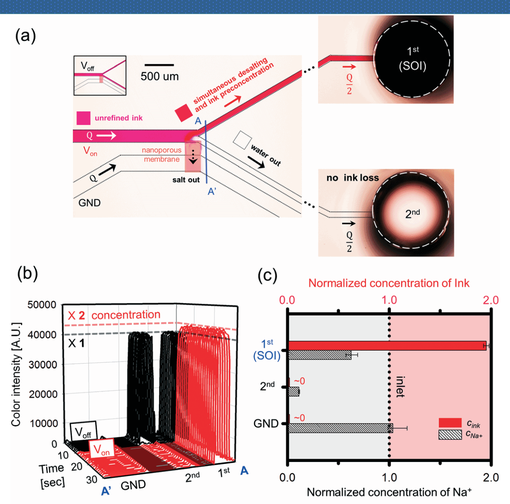


- The microstructures polarize the ion distribution by SC and EOF
- The flows show an elongated pattern and create an additional path for ion current

Lab on a Chip *20*, 675-686, 2020

Active Ion Control for Environmental Applications

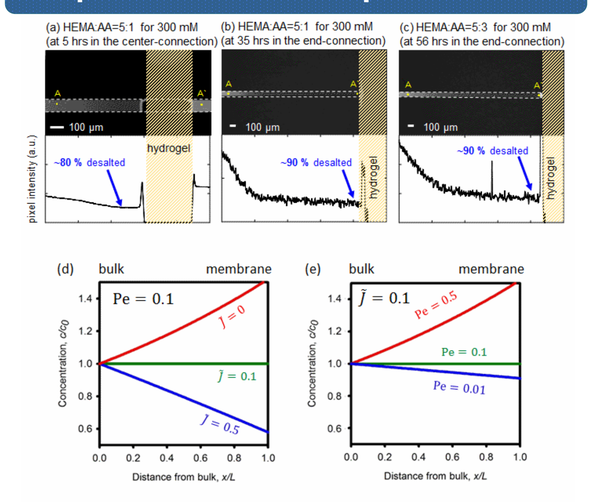
Simultaneous desalting / preconcentration



- Analytes larger than the size of nanopores were completely repelled by the ICP layer

Lab on a Chip *17*, 3841-3850, 2017

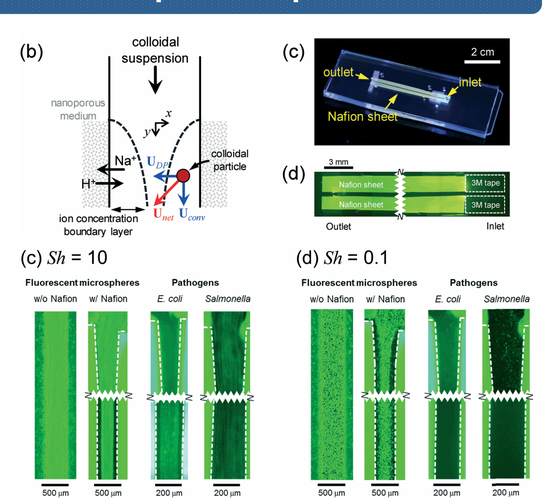
Spontaneous water purification



- Capillarity ICP device is able to desalting an ambient electrolyte without any external electrical power

Nature Communications *7*, 11223, 2016

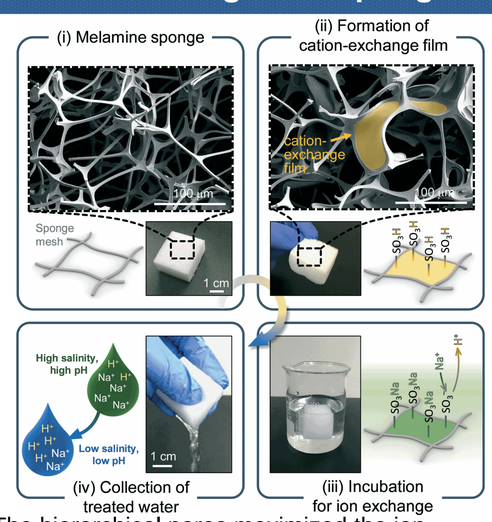
Diffusiophoretic purification



- Depending on Sh, long-range diffusiophoretic exclusion can be used for continuous water purification

Lab on a Chip *18*, 1713-1724, 2018

Ion Exchangeable Sponge



- The hierarchical pores maximized the ion-exchanging surface with the saline solution

Lab on a Chip *20*, 505-513, 2020