Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Enhanced Ion Transport by Controlling Electroconvection on Ion Exchange Membranes with Patterned Structures[1] JOONHYEON KIM, SANGHA KIM, RHOKYUN KWAK, Hanyang University, Korea — Patterned structure in fluid systems has been used to generate vortices, enhancing mass transfer. Here, we investigate new role of this vortex promoter, i.e. controlling an electrically driven hydrodynamic instability (a.k.a electroconvection (EC)) on ion exchange membranes. The patterned structures not only generates vortices as a vortex promoter, but also acts as a shelter to keeping EC from being suppressed by shear flow. To verify these effects, we visualized EC over six different patterns under various applied voltages. The strength of EC was then quantified by visualizing velocity and vorticity fields. In current-voltage response, we found that i) conductive ion flux is inversely proportional to the occupied area of the pattern in Ohmic regime, ii) stronger vortex promotion with a larger vortex area induces a shorter or even negligible length of limiting regime, and iii) the area of sheltered EC benefiting from the pattern is directly proportional to the convective ion flux in overlimiting regime. Considering relationship between ion flux and roles of structures synthetically, isosceles triangle pattern shows the highest ion flux through the membrane as it is the best option for a conductor and the second best for the vortex promoter and EC shelter.

[1]This work was supported by the Climate Change Response Technology Development Project (NRF-2017M1A2A2047475) and the Basic Research Project (NRF-2019R1C1C1008262) from the National Research Foundation of Korea.

Joonhyeon Kim
Hanyang University, Korea

Date submitted: 01 Aug 2019 Electronic form version 1.4