Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Microscale membrane capacitive deionization: Concentration profiling and flow visualization with unipolar/bipolar connections[1] HAHNSOLL RHEE, RHOKYUN KWAK, Hanyang Univ — Membrane capacitive deionization (MCDI) is a desalination method that uses electrically polarized porous electrodes as an ion adsorber and cation/anion exchange membrane to prevent co-ion desorption from the electrodes. To operate MCDI, we have two options, i.e., unipolar and bipolar connections. In unipolar connection, porous electrodes are directly connected to an electrical source, while the electrodes are floated under an electric field in bipolar connection. Here, we study the relative superiority of unipolar/bipolar connections of MCDI under various current regimes and stack numbers. To do this, we present a microscale MCDI platform that can visualize *in situ* ion concentration and fluid flows. In both unipolar/bipolar connections, similar characteristics of ion concentration and fluid flows were observed in ohmic, limiting, and over-limiting regimes. However, the different trends of desalination performances were identified in the two connections according to the stack number. In unipolar connection with various stack numbers, salt removal ratio, energy per ion removal, and current efficiency were nearly constant under a fixed applied current, whereas the three metrics were worsened in bipolar connection as stack number increases. As a result, MCDI in bipolar connection is proper for highly efficient but low throughput applications. On the other hand, MCDI in unipolar connection is proper for high throughput but low efficient application.

[1]This work was supported by Samsung Research Funding IncubationCenter of Samsung Electronics (SRFC-MA1901-08).

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Date submitted: 10 Aug 2020 Electronic form version 1.4