

# Electrochemical methods for water treatment

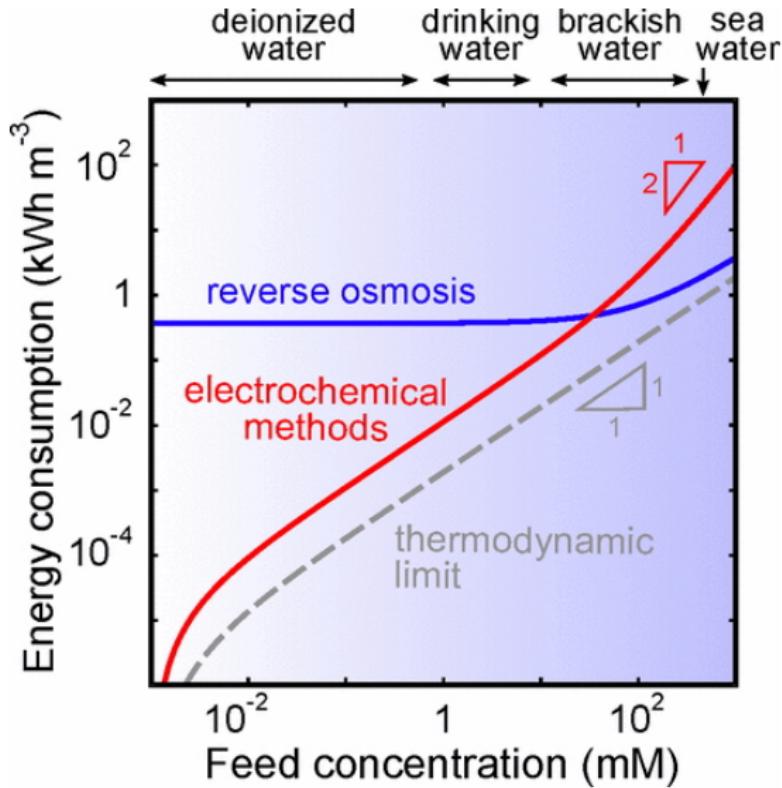
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# Outline

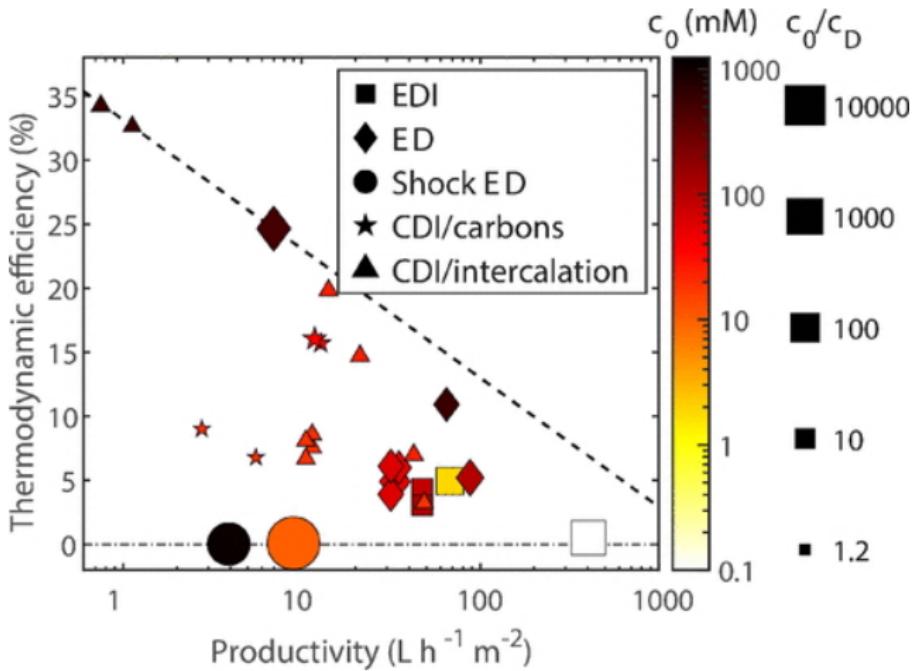
1. Motivation
2. Thermodynamic efficiency of different methods
3. Kinetics of capacitive deionization
4. Transport: Identifying mechanisms of electrosorption

# Why the status quo is not enough

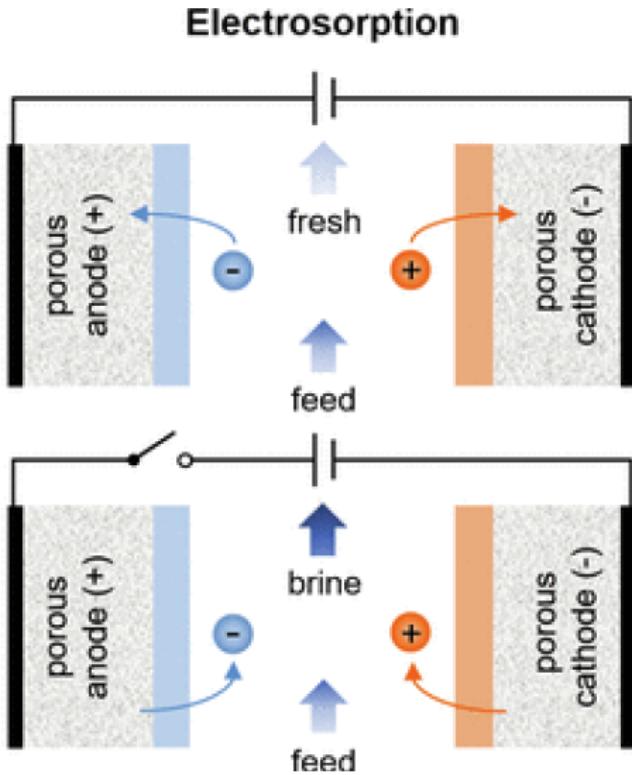


# Thermodynamic efficiency of different methods

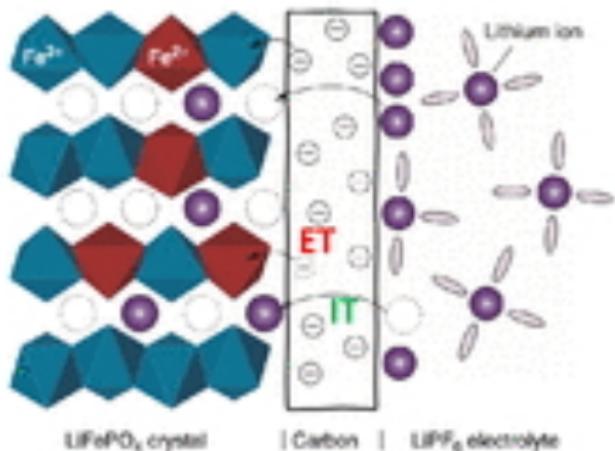
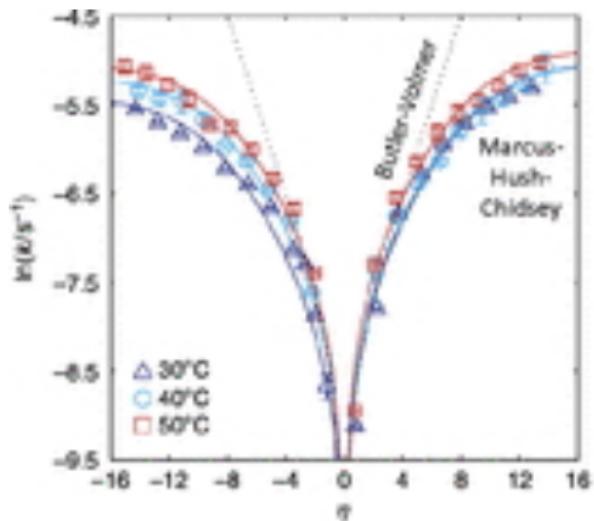
We can plot  $\mathcal{P} = \frac{V_D}{nA}$  vs.  $\eta = \Delta\hat{G}/\hat{E}$



# What electrosorption looks like



# A coupled ion-electron transfer mechanism for CDI

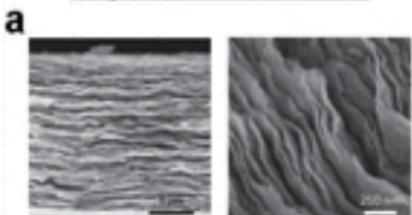


$$\lambda_0 = \frac{e^2}{8\pi\epsilon_0 k_B T} \left( \frac{1}{a_0} - \frac{1}{2d} \right) \left( \frac{1}{\epsilon_{op}} - \frac{1}{\epsilon_s} \right)$$

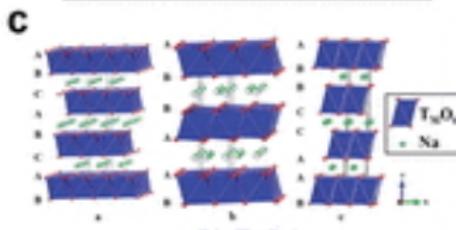
# Identifying Faradaic vs. electrostatic electrosorption

## Intercalation Materials

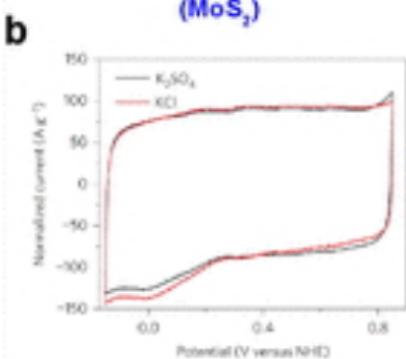
### Physical Intercalation



### Redox-Active Intercalation



(MoS<sub>2</sub>)



(NaT<sub>M</sub>O<sub>3</sub>)

d  $T_M = \text{Ti, V, Cr, Mn, Fe, Co, Ni}$

