THE Water Research FOUNDATION

Paul L. Busch Award

2020 Paul L. Busch Award and Lecture

10/29/2020

Agenda

3:00p ET	**Welcome** Lola Olabode and Peter Grevatt – The Water Research Foundation
3:03p	**Get to Know Paul L. Busch** Doug Owen, Glen Daigger, and Lisa Busch
3:13p	**Testimonials from Past Paul L. Busch Awardees** David Sedlak *PLB 2003* and Paul Westerhoff *PLB 2006*
3:18p	**2020 Paul L. Busch Awardee** Paul Westerhoff PLB 2006
3:20p	**2020 Award Lecture** **Toward Selective Solute Separation (S^3) for Sustainable Water and Wastewater Treatment** Dr. Shihong Lin
3:45p	**Panel Discussion** Glen Daigger, David Sedlak and Paul Westerhoff
3:55p	**Congratulations**
3:58p 4:00p	**Adjourn**

Get to Know Paul L. Busch

Get to Know Paul L. Busch | *Doug Owen*

Get to Know Paul L. Busch | *Glen Daigger*

Get to Know Paul L. Busch | *Lisa Busch*

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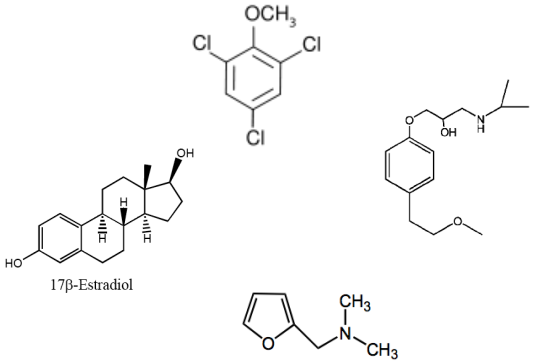
Testimonials from Past Paul L. Busch Awardees

David Sedlak *PLB 2003* and Paul Westerhoff *PLB 2006*

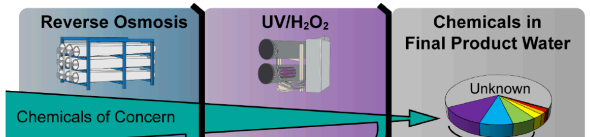
Impact of 2003 Paul L. Busch Award

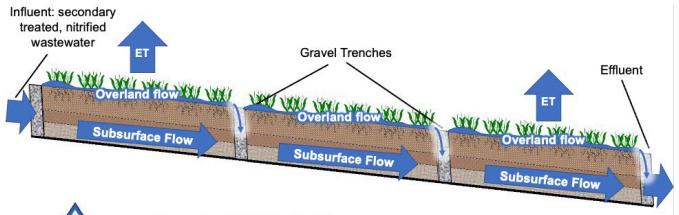
David Sedlak, Plato Malozemoff Professor– UC Berkeley

Topic: Trace Organic Contaminants in Municipal Wastewater Effluent



People + Ideas = Change



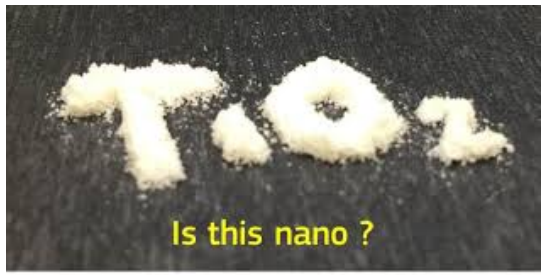


ReNUWIt
Re-inventing the Nation's
URBAN WATER INFRASTRUCTURE

Impact of 2006 Paul L. Busch Award

Paul Westerhoff, PhD, PE, BCEE – Arizona State University

Tools to Characterize and Understand the Risk of Biogenic and Commercial Nanomaterials in Wastewater Effluents

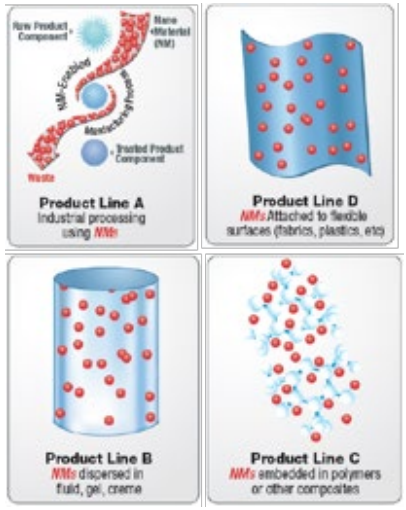


Environmental Science Nano

Implications

LC nano

9 university EPA Center



Applications

NSF Nanosystems Engineering Research Center for Nanotechnology Enabled Water Treatment Systems (NEWT)

RICE ASU Yale UTEP

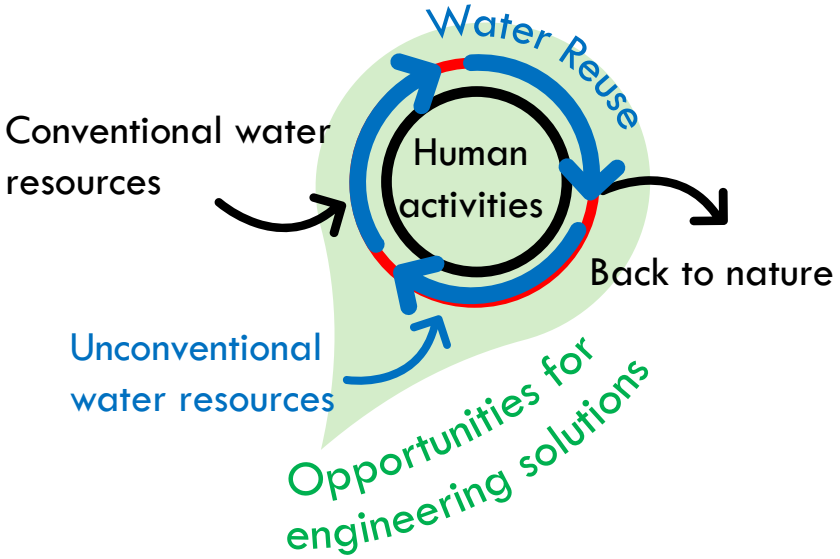
THE Water Research FOUNDATION

Toward Selective Solute Separation (S^3) for Sustainable Water and Wastewater Treatment

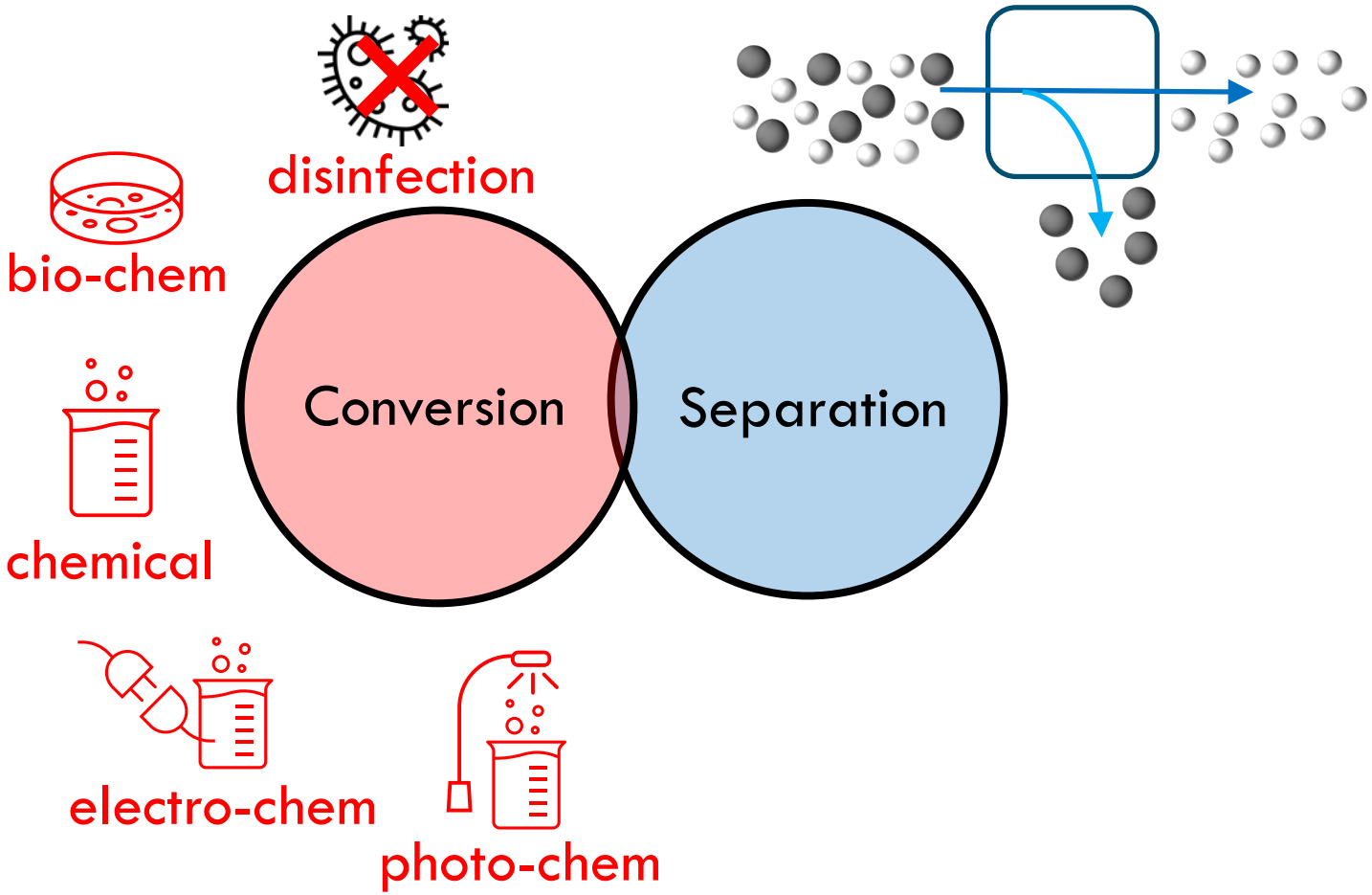
Shihong Lin, Vanderbilt University

10/29/2020

The urgent need for engineered solutions to address water scarcity problem

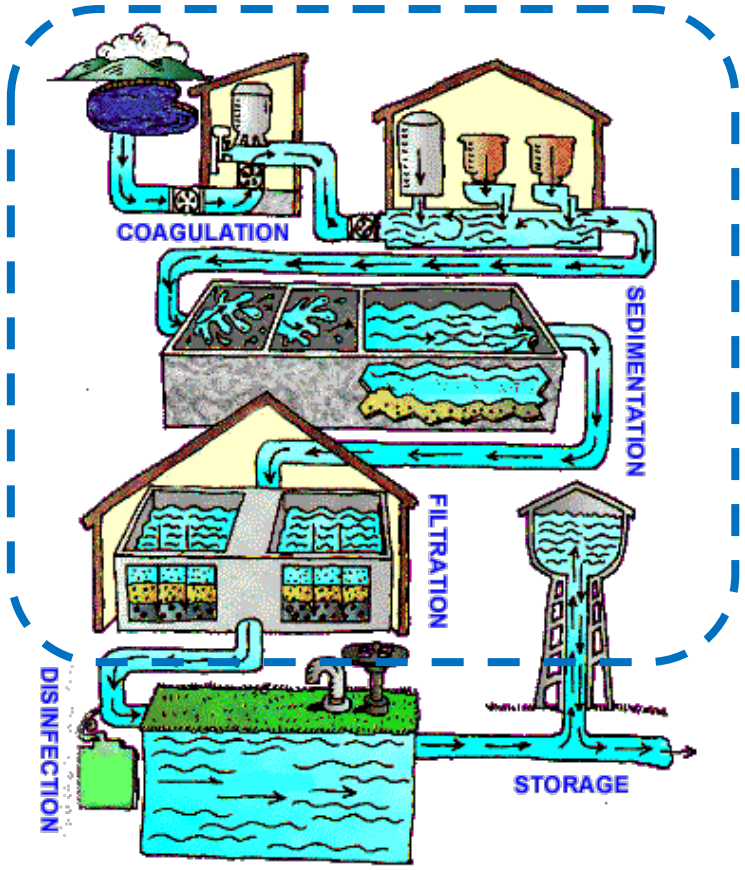


The two types of things we do in water or wastewater (w/ww) treatment



Common separation processes in w/ww treatment

Drinking water treatment



(*Image source: CDC.gov*)

Secondary clarifier

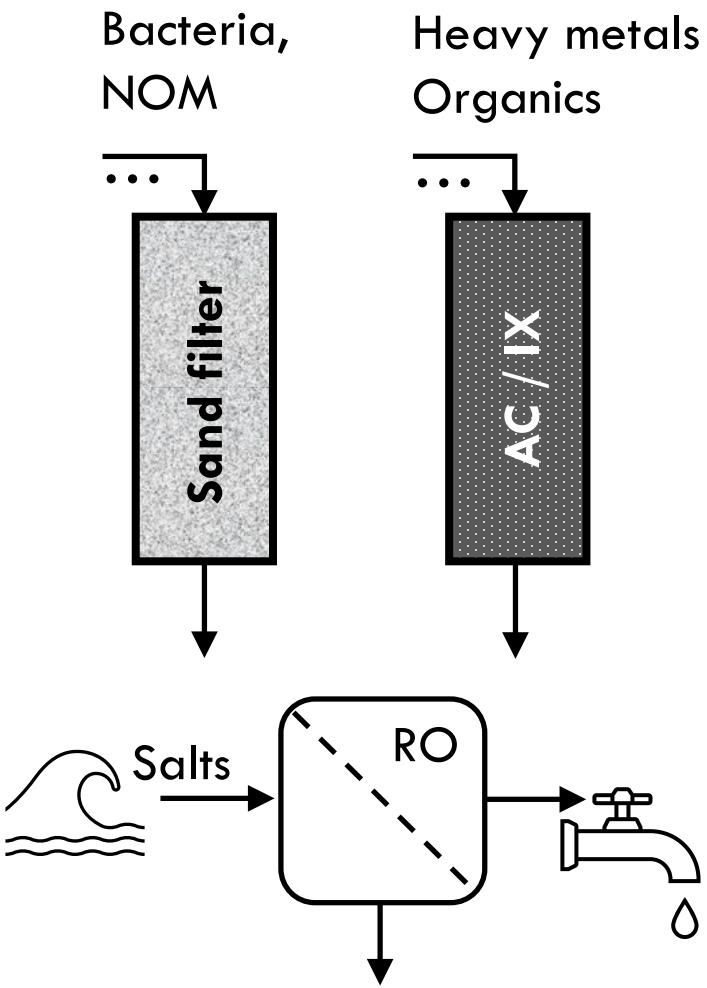
(*Image source: Evoqua*)

SWRO plant

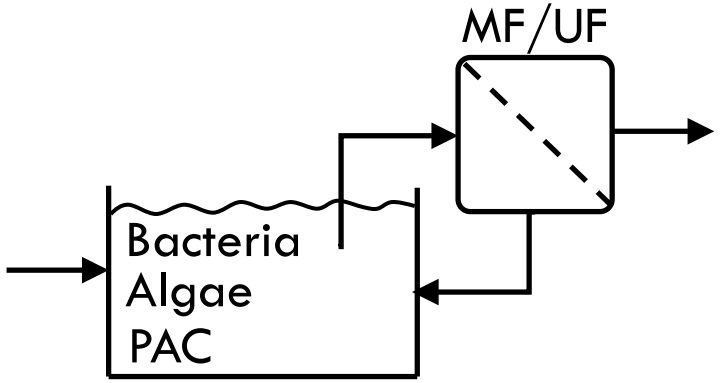
(*Image source: Poseidon Water*)

Why separation in w/ww treatment?

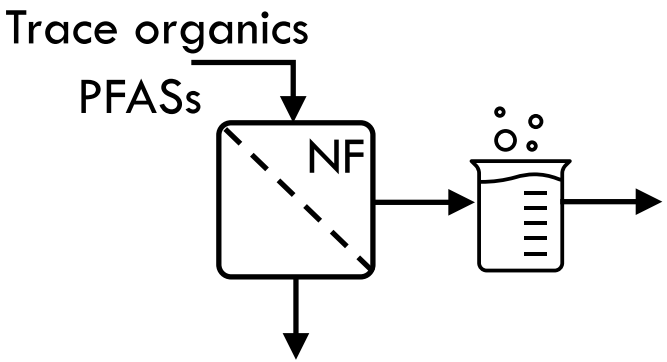
Remove stuff



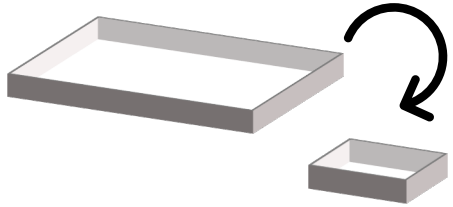
Retain stuff



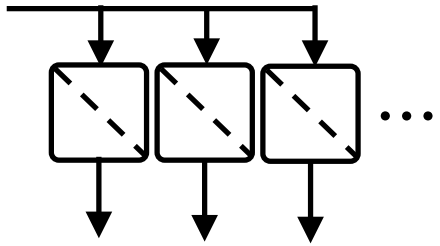
Concentrate stuff



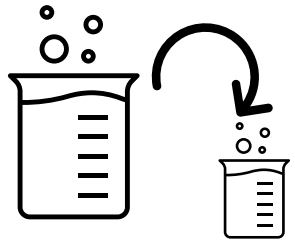
The rise of membrane separation



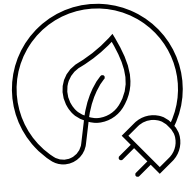
Smaller footprint



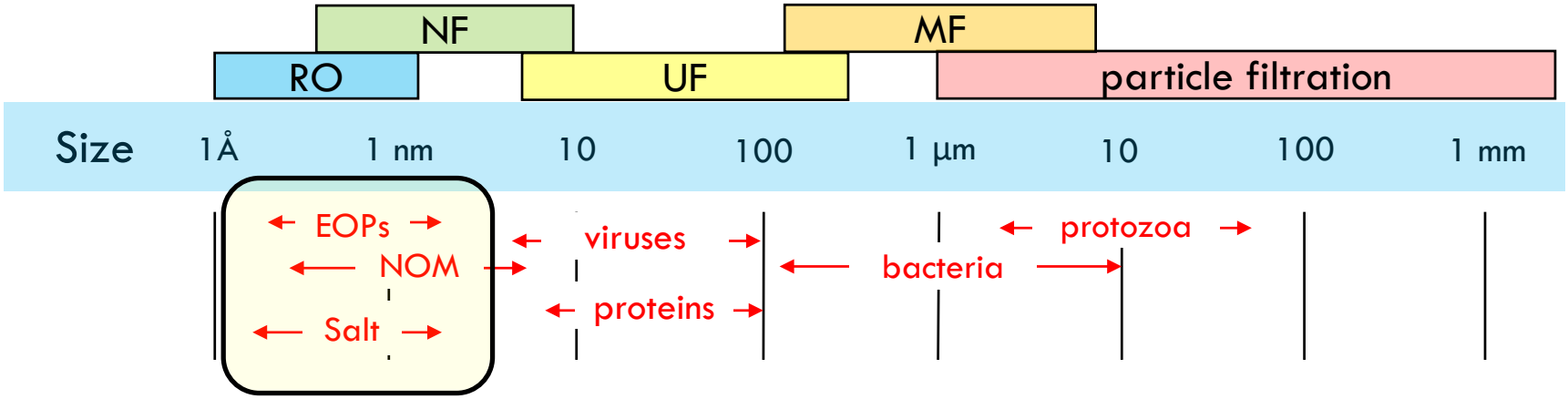
Modular



Reduced chemical use

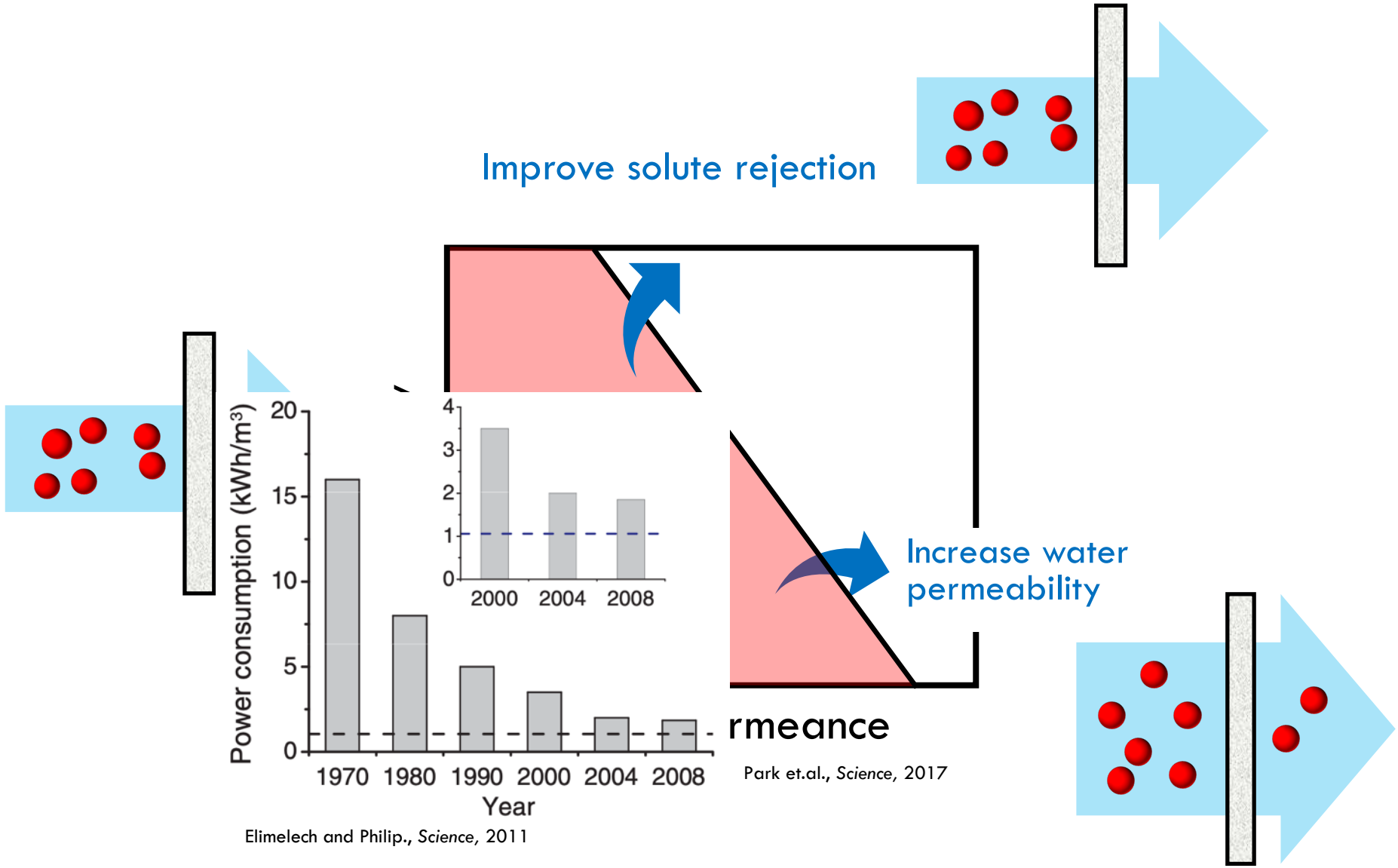


Energy efficient*



Focus on this talk

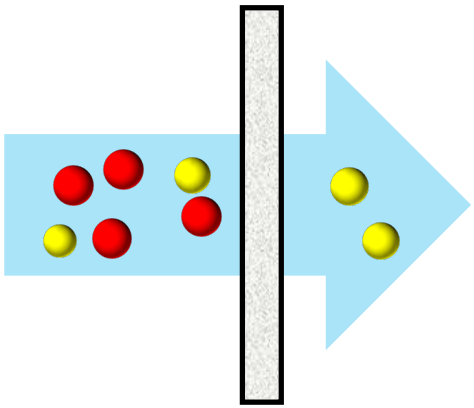
Improving solute separation membranes



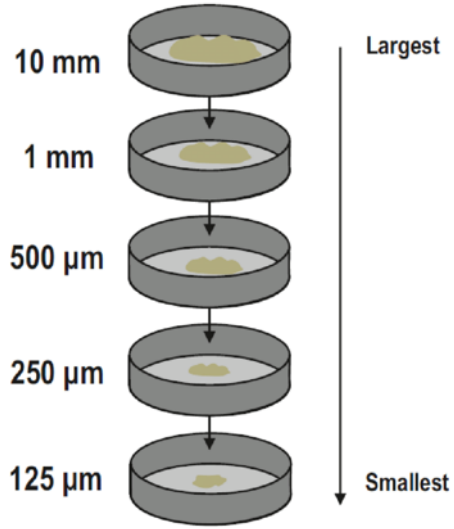
Elimelech and Philip., *Science*, 2011

Park et.al., *Science*, 2017

Selective solute separation (S^3) as the new frontier of membrane separation



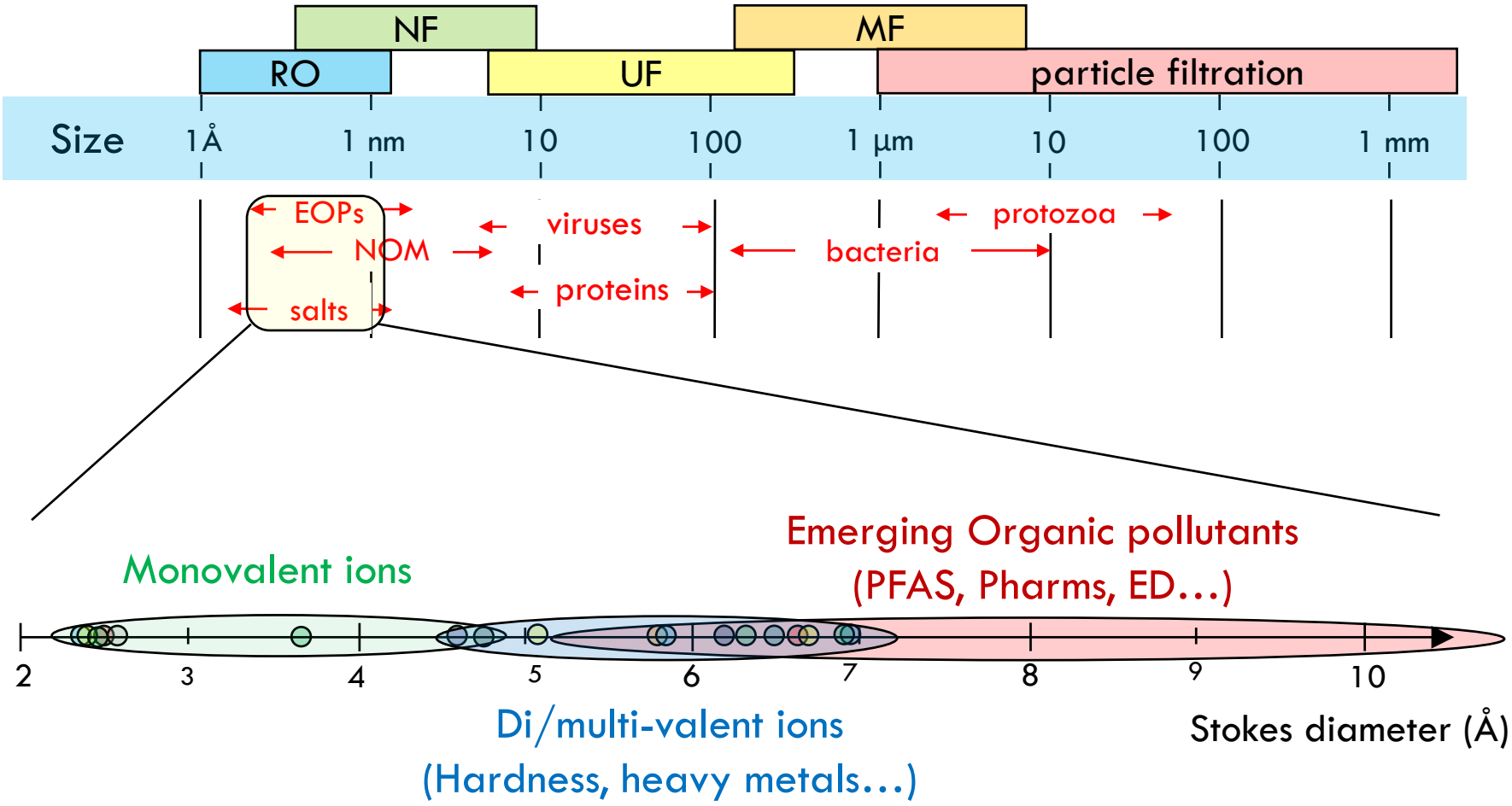
Epsztein et.al., *Nature Nanotech.*, 2020



The old art of sieving

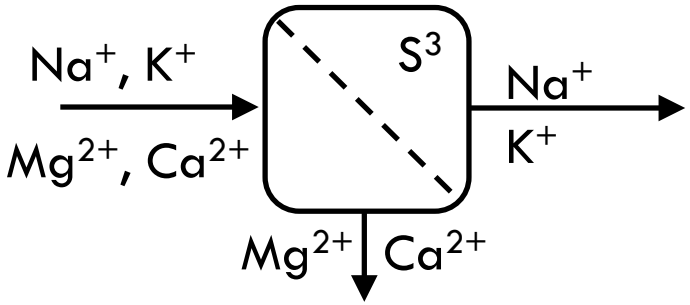
but at molecular level

Zooming in on the separation spectrum

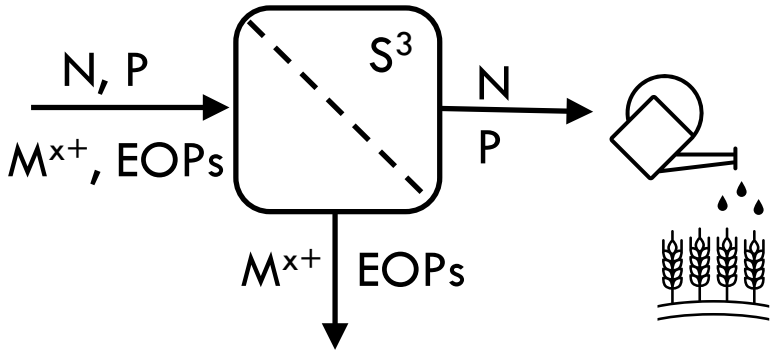


Why precise S^3 ?

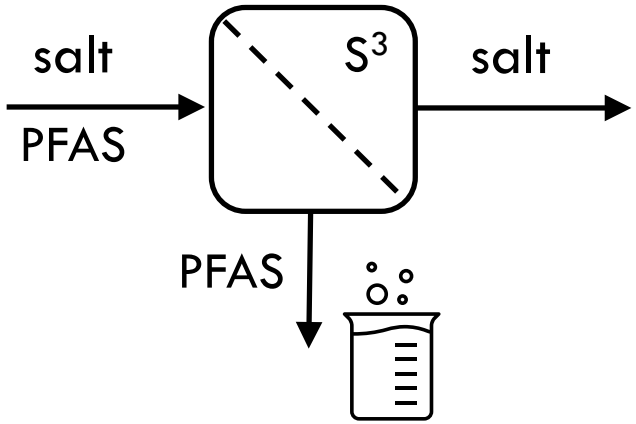
Water softening



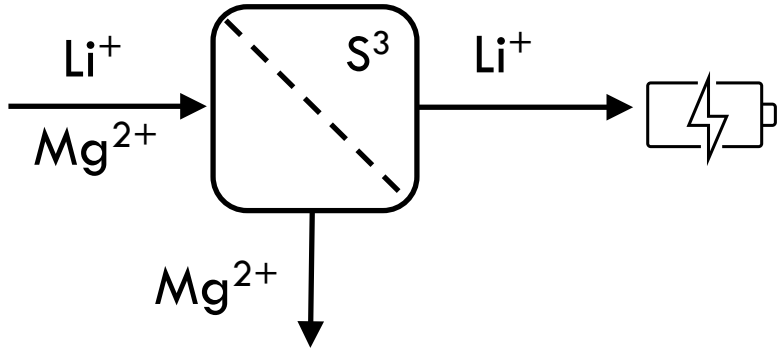
Wastewater reuse



Process intensification

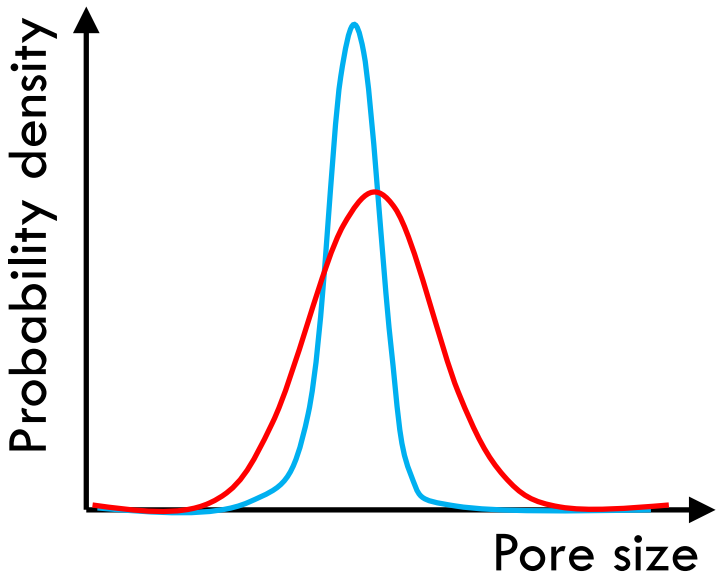


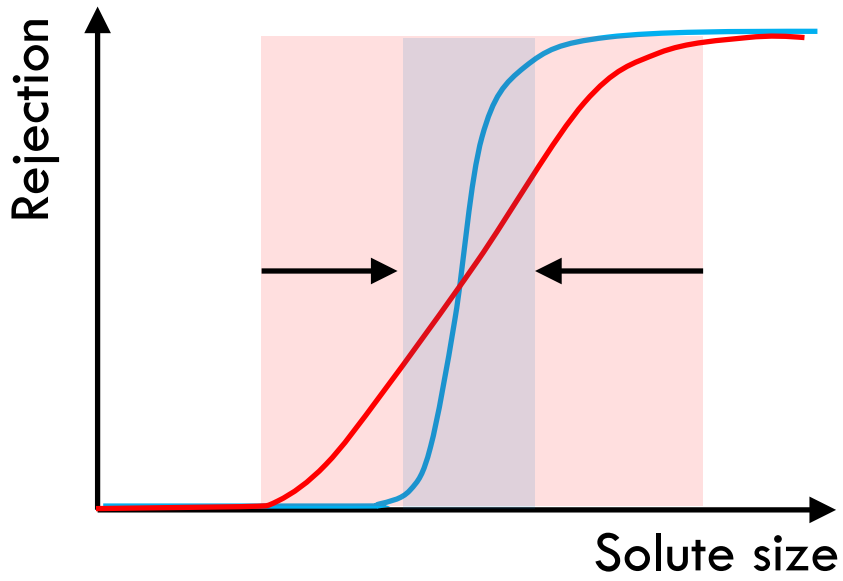
Resource mining

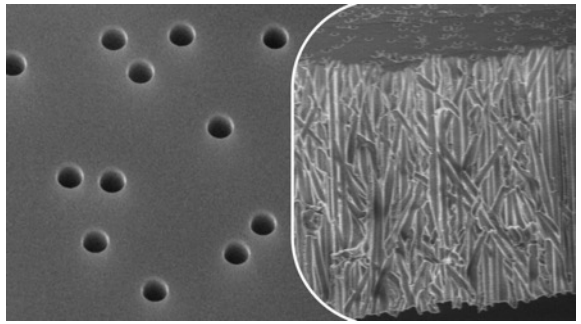


and more…

Precise S^3 and its challenges



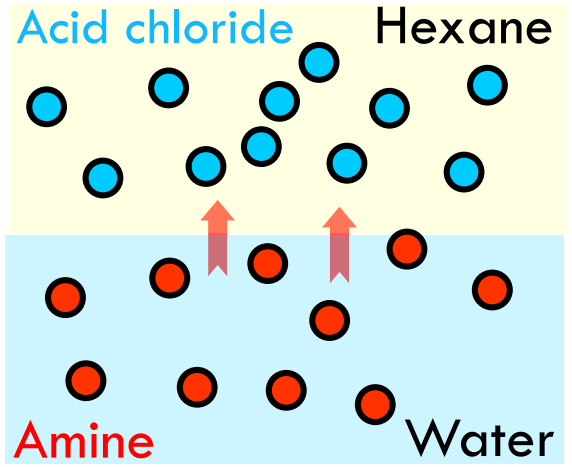


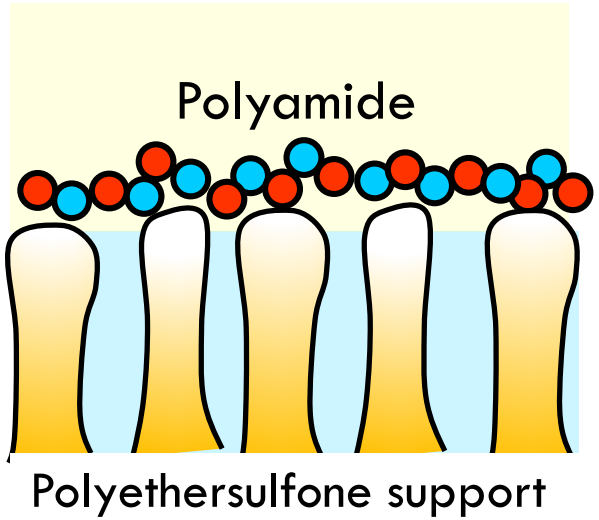


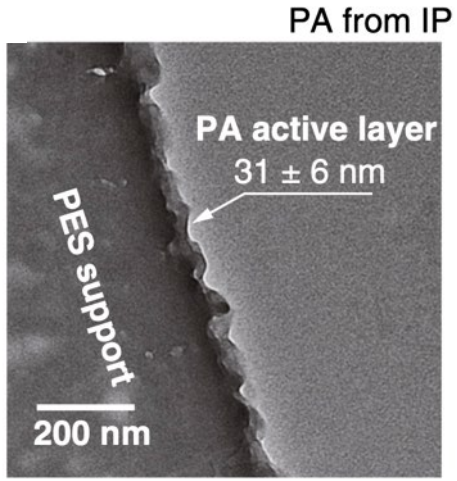
(*Image source: it4ip.be*)

- Has been achieved in MF membranes via track-etching.
- But track-etching cannot create sub-nanometer pores for NF.

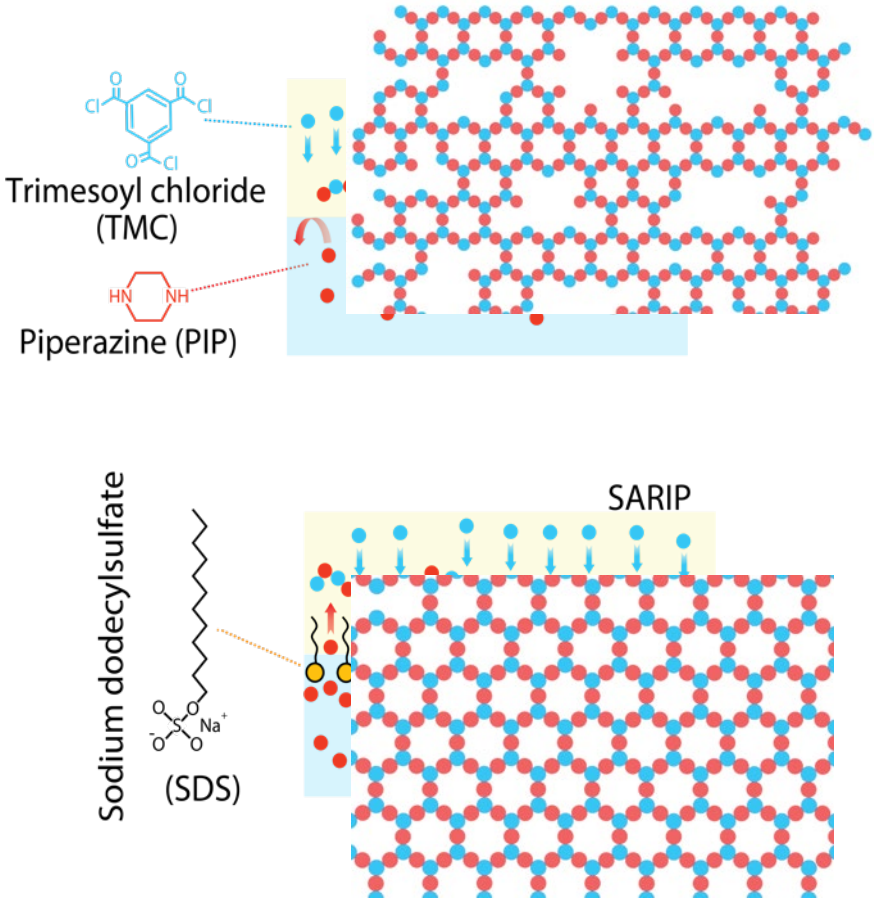
Interfacial polymerization: the industrial state-of-the-art

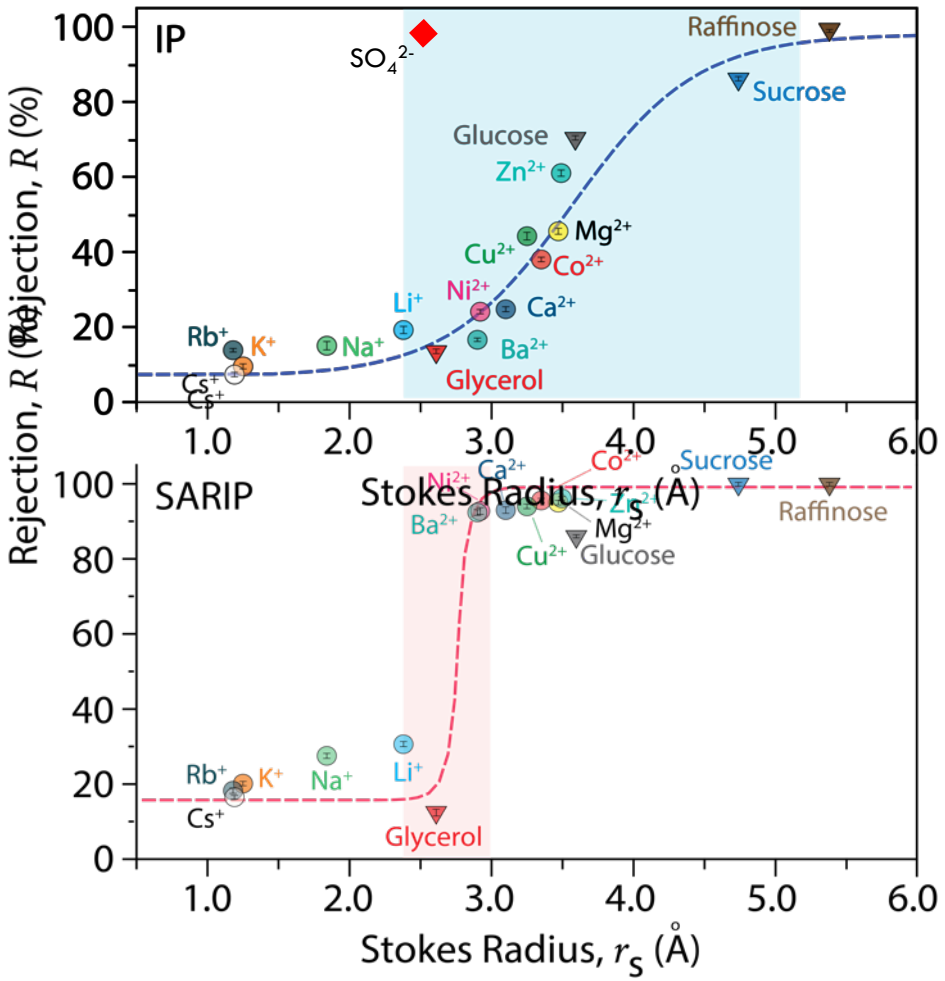






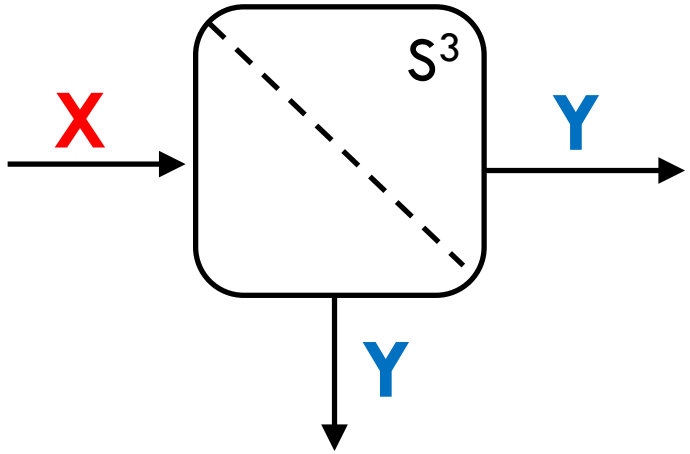
Polyamide membrane with sub-1 Å precision for S^3





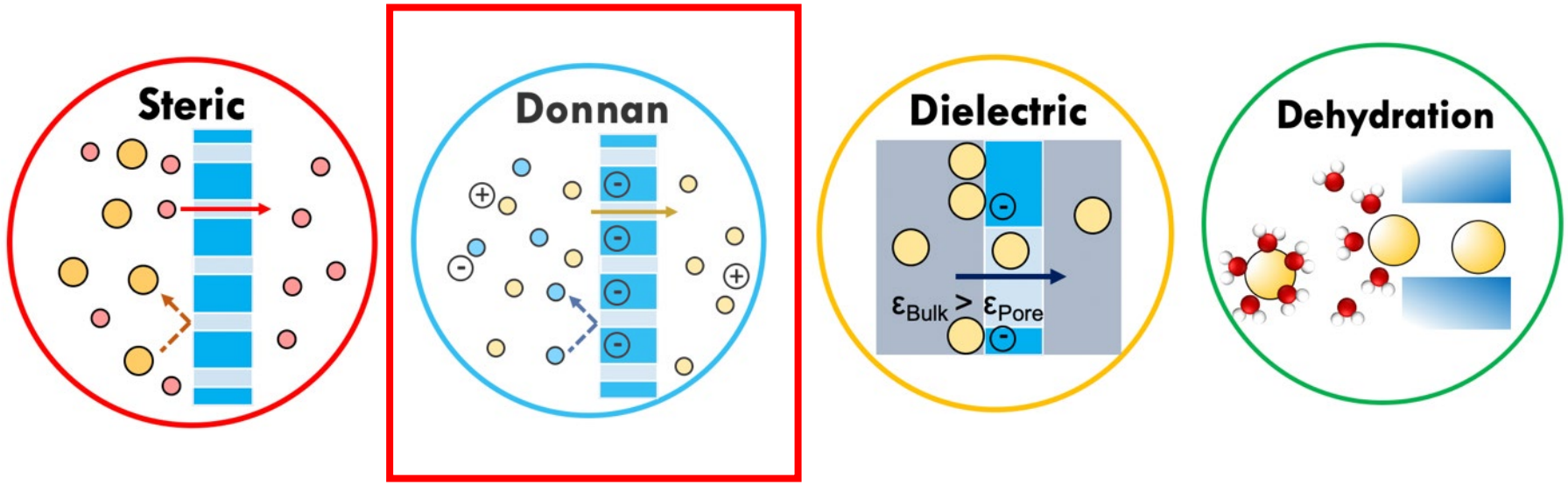
Liang et.al., *Nature Comm.*, 2020

Can we make S^3 more adaptable?

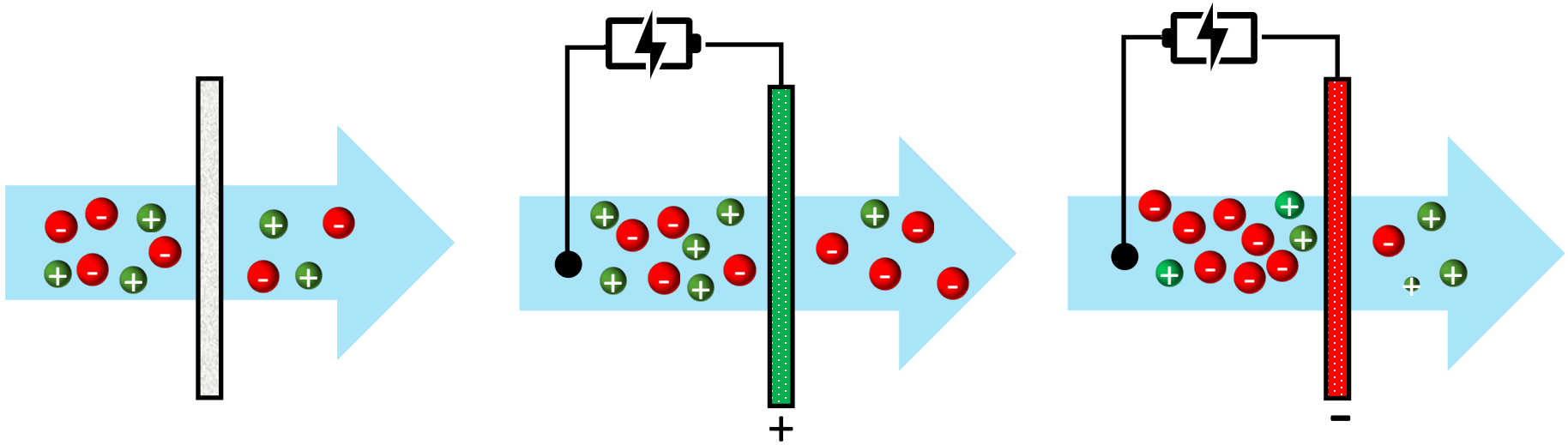


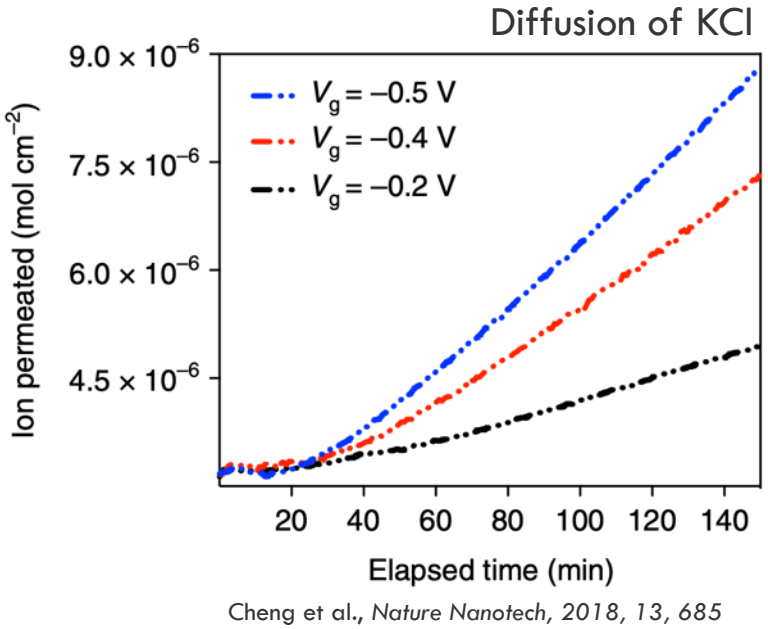
- applicable in multiple scenarios
- accommodate temporal variations in feedwater quality
- control product water quality on demand

Unlikely with conventional NF process



Electro-regulated nanofiltration (e-NF)

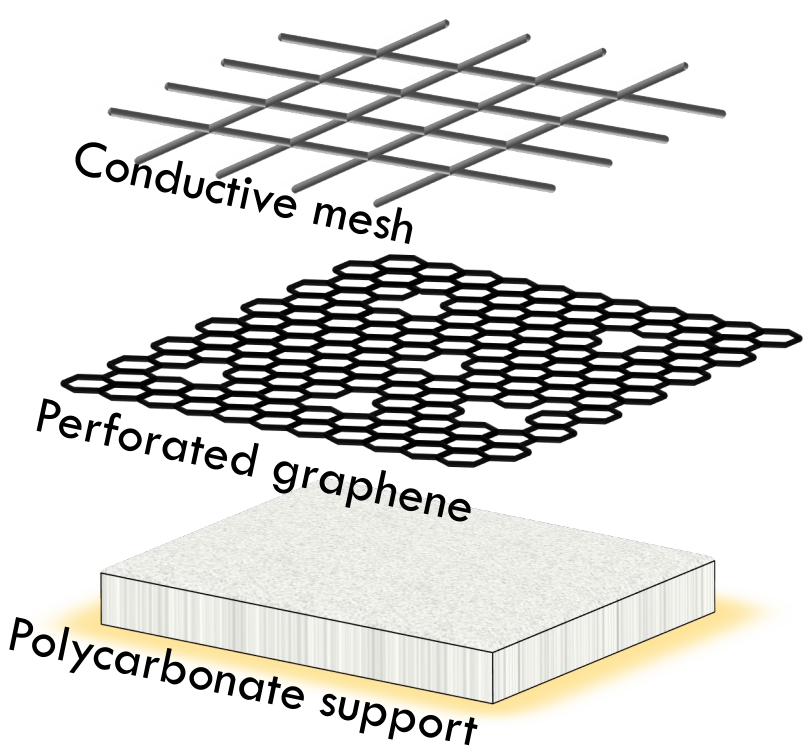


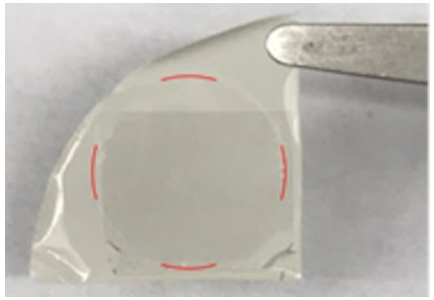


Cheng et al., *Nature Nanotech, 2018, 13, 685*

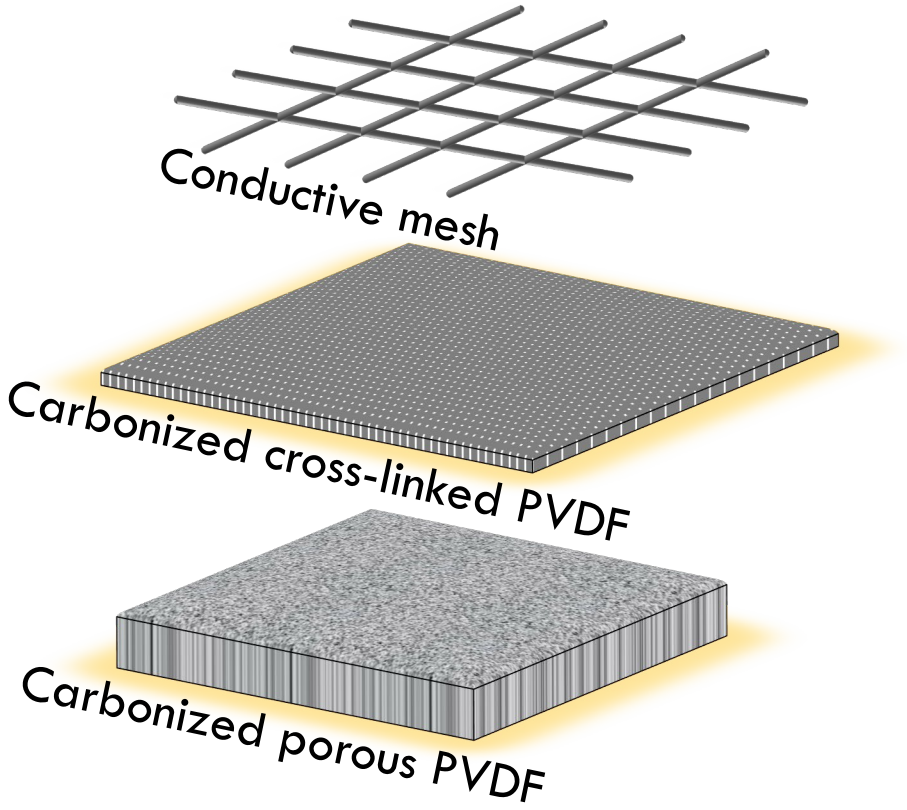
- Positive vs. negative
- Multivalent vs. monovalent
- Charged vs. neutral

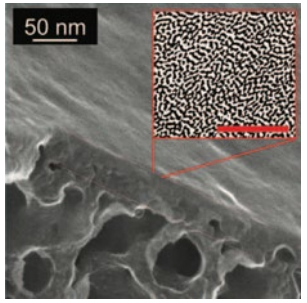
Electro-regulated nanofiltration (e-NF)





Cheng et.al., *Nano Lett.*, 2020





Koh et.al., *Science*, 2016

Summary

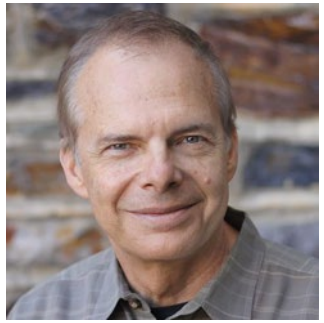
- Selective solute separation (S^3) is the new frontier of membrane-based water separation
- Electro-regulated NF (e-NF) can potentially make S^3 more adaptable.
- The Paul L. Busch Award will support the development of e-NF and advancing the fundamental understanding of S^3.

Many thanks to

THE Water Research FOUNDATION

- Paul L. Busch Award Sponsors
- Water Research Foundation

- Lin Research Group



- Mentors (Meny and Mark)

- Yanting, Shiloh, and Charlotte

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Panel Discussion

Glen Daigger, David Sedlak and Paul Westerhoff

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Congratulations!