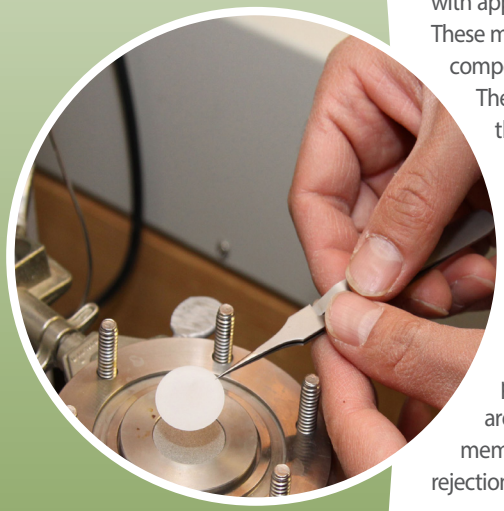
Sandia National Laboratories

Energy, Climate & Infrastructure Security

Biomimetic Membranes for Water Purification

Access to clean water impacts public health, agriculture, and energy production worldwide. We're developing new membranes with higher water purification efficiency to create a future where clean water is more cheaply available.



Biomimetic membranes have the potential to produce clean water more efficiently than current state-of-the-art reverse osmosis membranes and could provide easier access to cheaper, clean water while lessening demands on the electrical energy production used for desalination.

Water Purification at Lower Energy Costs

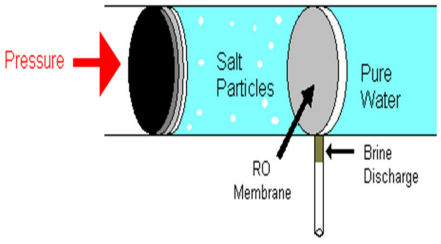
Using natural membrane-bound biological channels as inspiration, biomimetic membranes are made from self-assembled nanopores tuned with atomic layer deposition. Biomimetic membranes are designed to purify water using reverse osmosis (RO) technology, which removes impurities from water with applied pressure powered by electrical energy. These membranes filter out salts and larger solution components, leaving behind clean drinking water. The engineered pores define the active sites that block ions and enable high salt rejection and faster water flow at lower driving pressures than competing membranes, reducing the energy cost of desalination. In small-scale lab experiments, with rigid membranes the size of a quarter, our biomimetic membrane achieved an order-of-magnitude improvement in membrane permeability to water flow (at a pressure around 5.5 bar) compared to commercial membranes, while still maintaining high salt rejection ratios.

Application for Water Desalination

Biomimetic membranes possess the potential to create a significant beneficial impact on the worldwide water purification market. The improved water flux of biomimetic membranes has the potential to reduce energy costs due to membrane resistance to flow up to 80%. More than half of the 15,000 desalination plants around the world utilize reverse osmosis technologies, and implementing biomimetic membranes on a large scale could amount to a possible savings of hundreds of millions of dollars in electrical energy cost annually.

Application for Other Separations

Biomimetic membranes can be tuned to provide efficient liquid and gas separation for a wide variety of industrial applications. For example, by modifying the biomimetic membrane, the nanoporous architecture could reject toxic boric acid and arsenic while simultaneously facilitating water transport



for efficient wastewater purification. In addition, the membrane could be altered for carbon dioxide capture and sequestration or possibly electrical energy storage applications in lithium-ion batteries.

R&D Partnerships to Date

Sandia National Laboratories jointly developed this technology with researchers from the University of New Mexico. It was awarded an R&D 100 Award in 2012, and patents on the technology are pending. We are now actively seeking partnerships with industry, through a CRADA or Work-for-Others agreement, to help us develop this technology and apply it to flexible substrates. These membranes would then need to be scaled up to a commercial size that can be utilized in existing commercial vessels used for reverse osmosis water desalination. We are also interested in working with industry to apply this technology to other applications that may fit their needs and significantly reduce their electricity requirements to achieve separations.

Commercializatioan Path

Currently we consider this technology to be at a Technology Readiness Level (TRL) of 3, meaning small scale lab experiments have been completed to prove the concept. We now need industry partners to work with us to take this to the next level—create prototypes and then test them in commercial applications—to truly realize the potential of this technology.

If industry is interested in licensing this patent pending technology, and working with Sandia National Laboratories and the University of New Mexico, then please contact us or the Science and Technology Center at UNM (STC.UNM) directly.

For more information please contact:

Sandia National Laboratories
Email: IP@sandia.gov

Susan Rempe
Email: slrempe@sandia.gov

STC.UNM
E-mail: ebeaumont@stc.unm.edu
https://stc.unm.edu/

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