RESEARCH BRIEF
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NAWI National Alliance for Water Innovation

Multifunctional Membrane for Oxyanion Removal

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Challenge

Climate change and water scarcity are driving various entities in arid regions to explore treating and utilizing non-traditional water sources (e.g., contaminated groundwater) as a way to bolster existing supplies. However, groundwater can contain elevated concentrations of naturally occurring heavy metals (lead, mercury, cadmium) and oxyanions (chromium, selenium) or can become contaminated through anthropogenic means. Regardless, groundwater with metals or oxyanions require treatment because consumption of these compounds have adverse health effects. Reverse osmosis, nanofiltration, adsorption, and ion-exchange are the state-of-the-art treatment technologies for metal/oxyanion removal but are often energy intensive, non-selective, or not configured to recover the captured materials. Therefore, a new technology is proposed that uses an integrated reduction-adsorption-filtration process that may overcome some of the most difficult challenges.

Research Approach

The objective of this project is to develop a platform technology that can selectively remove and recover metals/oxyanions from non-traditional water sources. Previously, the team demonstrated that a molybdenum sulfide (MoS_2)-based membrane could remove lead, mercury, cadmium, and copper with extremely high selectively.[1-3] This project will build off of previous research and take a systematic approach to developing MoS_2 membranes that can selectively remove chromium and selenium by:

1. Performing a market assessment and techno-economic analysis to identify key technology applications and performance goals.
2. Optimizing the synthesis of MoS_2 nanosheets for removal in complex waters, and identifying the fundamental removal mechanisms.
3. Developing scalable synthesis and regeneration strategies for a multifunctional membrane filter and an adsorption column, then evaluating performance.
4. Designing and constructing a prototype and comparing the technology's performance against state-of-the-art technologies.

Impact

In March of 2022, California lowered the Maximum Contaminant Level for chromium from 50 parts per billion (ppb) to 10 ppb in drinking water, meaning nearly 800 groundwater wells would be in violation, and over 1,300 monitoring wells may require additional review and regulatory oversight.[4] Successful completion of this project may generate a technology that enables the selective removal and recovery of metals/oxyanions from water, enabling the use of a non-traditional water source, significantly reducing the cost and energy of treatment, and valorizing compounds that would typically be considered waste.

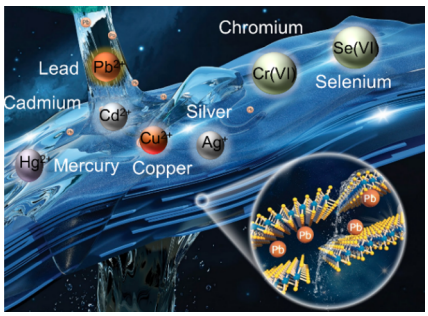

Figure 1. Multifunctional membrane for selective metal and oxyanion removal.[2]

RESEARCH PARTNERS

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