Australian Government

ANSTO
Science. Ingenuity. Sustainability.

Removal of dangerous contaminants from dirty water

Providing clean water for millions around the world is an ongoing challenge. Existing materials that sieve harmful ions from water are bulky and have short lifetimes. A group from Monash university has sought to make a new innovative nano-porous sieve material which has the potential to be produced on a global scale and is effective for a much longer time.

Research & Outcomes

One of the greatest challenges today, is the provision of clean water to all. Research is turning to new and innovative ways to clean the dirtiest, brackish water. Harmful ions such as lead and mercury are among the most common contaminants.

Polymers are by far the most widespread membrane materials, largely owing to their easy processability and low cost, However, traditional polymeric membranes for ion separation from water usually contain a dense layer, leading to limited selectivity. In contrast, nanoporous membranes, where thin uniform nanopores act as the sieving role, may overcome this limitation.

In a study led by Professor Xiwang Zhang, Researcher in the Department of Chemical Engineering at Monash University and the Director of the ARC Research Hub for Energy-efficient Separation, and Dr Qinfen Gu, Principal Scientist of the Powder Diffraction beamline at ANSTO's Australian Synchrotron, researchers for the first time developed water-stable monolayer aluminium tetra-(4-carboxyphenyl) porphyrin frameworks (termed AI-MOFs) nanosheets, and demonstrated their near perfection as building materials for membranes in ion separation from water.

"In this world-first study, we were able to use these ultrathin Al-MOFs to create a membrane that is permeable to water while achieving nearly 100 percent rejection of ions." Said Professor Zhang

This breakthrough study confirms that the intrinsic nanopores of Al-MOFs nanosheets facilitate the ion/water separation by creating vertically-aligned channels as the main transport pathway for water molecules, and was enabled by the unique capability of the Australian Synchrotron to analyse materials at the molecular level.

Using the Powder Diffraction beamline, the Monash team were able to understand the difference between the molecular structure of nanosheet samples, and samples at different temperatures, in order to test water purification performance.

Benefits & Impacts

This innovation could enhance the desalination process and transform the dirtiest water into something potable for millions of people across the world.

The membrane performed steadily for more than 750 hours using limited energy. It could also be manufactured on a global scale, pending further testing.

References

Meipeng Jian et al. (2020) *Science Advances*, 2020; 6 (23) DOI: 10.1126/sciadv.aay3998

https://www.sciencedaily.com/releases/2020/06/200608104710.htm