High Performance Nanofiltration Membranes

VANDERBILT UNIVERSITY
CTTC Center for Technology Transfer & Commercialization

Summary

A research team led by Professor Shihong Lin at Vanderbilt University has developed a novel method to enhance the performance of nanofiltration (NF) membrane. This new approach has three major benefits:

1) uses a class of additives that is **low-cost** and **widely available**
2) is readily **compatible** with **existing manufacturing** infrastructure
3) achieves **ultra-sharp selectivity** or **enhanced perm-selectivity**

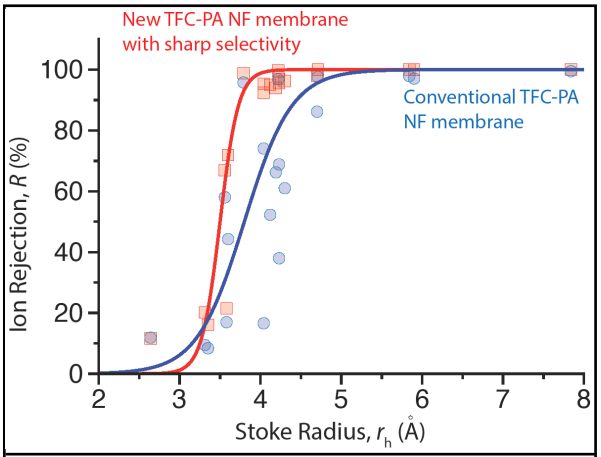

Figure 1: Ultra-sharp selectivity

Addressed Need

Interest in nanofiltration has grown significantly in recent years due to its strong potential to address many of the environmental problems that are under stringent regulations and the requirements for higher water quality in a variety of applications. Most existing membranes used in NF as well as reverse-osmosis applications face monetary and energy cost constraints, greatly limiting their commercial potential. The present membrane developed at Vanderbilt University would overcome these limitations through a unique active layer in the membrane that reduces both energy consumption and the costs associated with water purification and desalination. The novel membranes enable faster water transport through the membrane without compromising membrane selectivity, drastically reducing the required membrane area or energy consumption for the same target treatment productivity.

Technology Description

The novel membrane can be easily tuned using standard manufacturing techniques and commercially available additives to create a membrane with the desired performance characteristics. In one example use of this technology, a thin-film-composite (TFC) polyamide (PA) based membrane is fabricated using the present method and results in significantly higher water permeability and enhanced selectivity (see Figure 1). Another example of a loose NF membrane fabricated with this method can be seen in Figure 2A-B, where the membrane showed a more than five fold increase in permeability with increased rejection of humic acid, displaying superior performance to existing membranes. Furthermore, the membrane has excellent rejection for macromolecules and a sharp molecular weight cutoff at ~200 Da, while still being permeable to salts. Ultimately, there are many possibilities to tailor the membrane properties using this low cost method, all while continuing to remain compatible with existing manufacturing techniques.

Technology Development Status

The approach has been tested to be effective with different membrane materials and fabrication techniques (interfacial polymerization and layer-by-layer deposition). Further studies are ongoing to optimize performance and manufacturing.

Intellectual Property Status

A patent application has been filed.

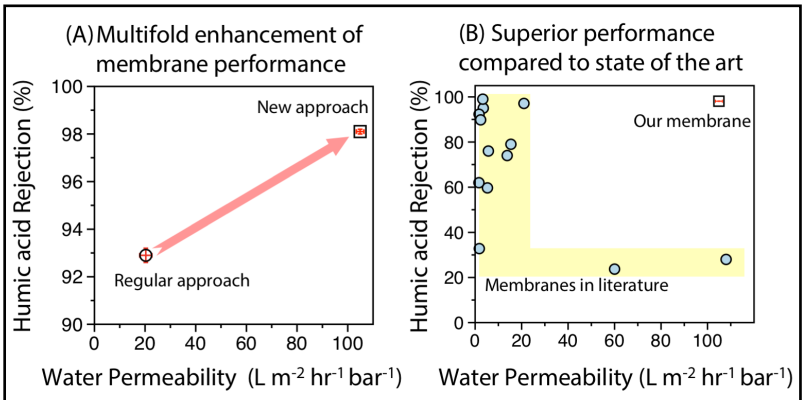

Figure 2: Increased rejection and permeability compared with existing membranes.

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