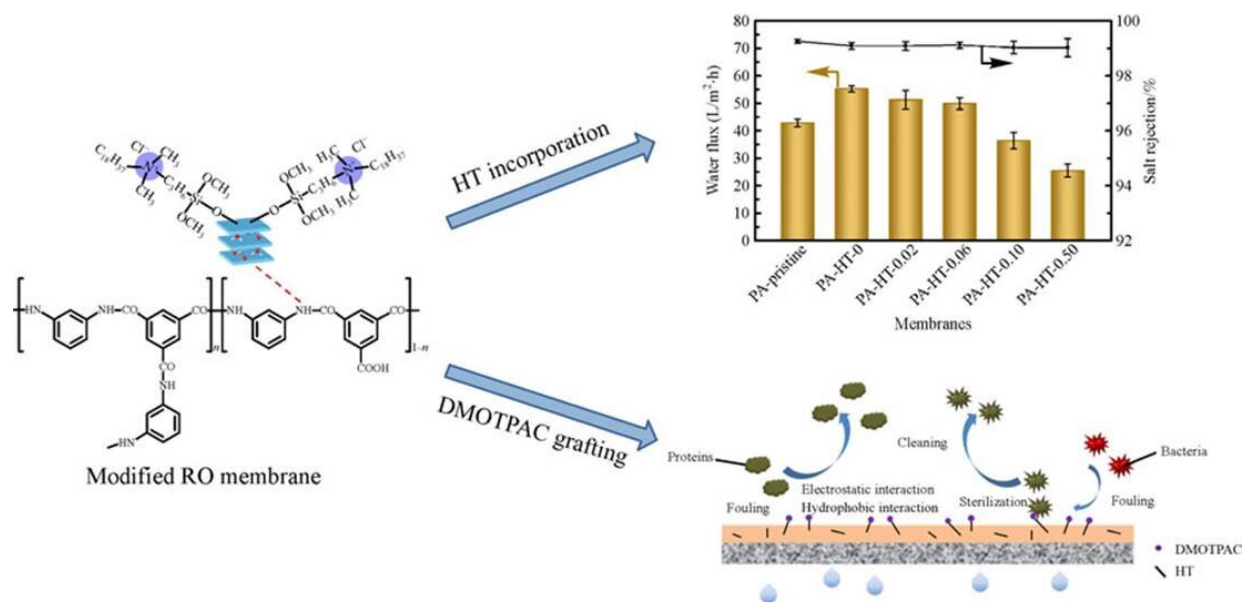


Novel technology to improve the high permselectivity and anti-biofouling properties of RO membranes

August 31 2022



Credit: Xinxia Tian et al

Reverse osmosis (RO) has attracted wide attention for its extensive applicability in brackish water and seawater desalination. Thin-film composite (TFC) polyamide (PA) RO membranes consisting of a dense separating layer and a porous support layer have been the leading products of this field. However, relatively low permeability-selectivity of PA RO membrane and membrane fouling of TFC RO membrane limit

the widespread applicability of TFC PA RO membranes.

The synthesis of nanocomposite membranes has been demonstrated to be an excellent technology to combine the advantages of polymers and inorganic nanomaterials. The native performance of RO [membrane](#) could be improved by fine-tuning the composition and structure. For example, hydrotalcite (HT) was dispersed in an aqueous solution and incorporated into PA matrix in the interfacial polymerization step to construct transport channels for water.

The obtained membrane exhibited high perm-selectivity with increased water flux without sacrificing salt rejection. In addition, membrane modification (including nanoparticle incorporation, surface coating and grafting) has been proved to be an efficient approach to prevent biofouling. Among them, grafting anti-biofouling agents on nanoparticles embed in the PA matrix could excellent strategy to endow RO membranes with anti-biofouling properties without damaging the PA matrix.

HT nanoparticles contain abundant hydroxyls, which can react with siloxy of silane coupling agents, allowing for ant-biofouling grafting. Consequently, novel TFC RO membranes with high perm-selectivity and anti-biofouling property can be obtained by employing HT nanoparticles as dopants in the PA layers and grafting silane coupling agents containing anti-biofouling [functional groups](#) on the membrane surface.

Inspired by the properties of HT nanoparticles and silane coupling agents containing quaternary ammonium, Prof. Jian Wang from the the Institute of Seawater Desalination and Multipurpose Utilization, Prof. Zhun Ma from the Shangdong University of Science and Technology, Dr. Xinxia Tian from the the Institute of Seawater Desalination and Multipurpose Utilization and their team members have worked jointly and developed novel RO membranes with prolonged and stable high

performance by improving the original perm-selectivity and anti-biofouling property simultaneously.

Their work greatly improves the performance of TFC PA RO membranes, which provides valuable technical guidance for desalination in the future. This study is published in *Frontiers of Environmental Science & Engineering*.

In this study, the Mg-Al-CO₃ HT nanoparticles were incorporated in PA layers during interfacial polymerization by dispersing in organic solutions. HT incorporation was performed with a dual role, enhancing water flux and acting as grafting sites. The HT incorporation increased the water flux without sacrificing the salt rejection, compensating for the loss caused by the following grafting reaction. The exposed surface of HT acted as grafting sites for anti-biofouling agent dimethyloctadecyl[3-(trimethoxysilyl)propyl] ammonium chloride (DMOT-PAC).

The combination of HT incorporation and DMOT-PAC grafting endowed RO membranes with high perm-selectivity and anti-biofouling properties. The water flux of PA-HT-0.06 was 49.8 L/m²•h, which was 16.4% higher than that of the pristine membrane. The salt rejection of PA-HT-0.06 was 99.1%, which was comparable to that of the pristine membrane. As to the fouling of negatively charged lysozyme, the water flux recovery of the modified membrane was higher than that of the pristine membrane (e.g., 86.8% of PA-HT-0.06 compared to 78.2% of PA-pristine). The sterilization rate of PA-HT-0.06 for *E. coli* and *B. subtilis* were 97.3% and 98.7%.

This study is the first to report the formation of covalent bonds between DMOT-PAC and HT nanoparticles embedded in PA matrix to obtain RO membranes with both high perm-selectivity and anti-biofouling properties. The integration [nanoparticles](#) incorporation and functional

group grafting pledges the development of RO membranes with high permselectivity and anti-biofouling properties.

More information: Xinxia Tian et al, Preparation of reverse osmosis membrane with high permselectivity and anti-biofouling properties for desalination, *Frontiers of Environmental Science & Engineering* (2021). DOI: [10.1007/s11783-021-1497-0](https://doi.org/10.1007/s11783-021-1497-0)

Provided by Higher Education Press

Citation: Novel technology to improve the high permselectivity and anti-biofouling properties of RO membranes (2022, August 31) retrieved 4 February 2023 from <https://phys.org/news/2022-08-technology-high-permselectivity-anti-biofouling-properties.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.