Antifouling and Chlorine-resistant Ultrathin Coatings on Reverse Osmosis Membranes

Technology #16133

Applications

The invented Zwitterionic coating applied on commercially available RO membranes has excellent potential of providing chlorine-resistant, antifouling surfaces. This technology is very useful in the water purification and desalination industry.

Problem Addressed

Other antifouling coatings have been applied to various surfaces by processes that involve the use of harsh solvents. These solvents may cause damage to delicate substrate (such as RO membranes). The invented copolymer chemistry is the first-ever ultrathin (30 nm) and ultralow-fouling coating developed by initiated chemical vapor deposition (iCVD), a solvent-less technique. The ultrathin nature of the coating ensures unchanged productivity of purified water, because water flux decreases exponentially as coating thickness increases. Additionally, while fouling from membrane use can be reduced by remediation with chlorine, exposure to water with even a few parts per billion chlorine significantly degrades normal membrane performance. This polymer coating is chlorine-resistant, lowering the number of additional processing steps and, in turn, operational costs.

Technology

The inventors have developed a novel antifouling chemistry that is also chlorine-resistant. The coating derives from poly(4-vinylpyridine) (P4VP), which has been used as the precursor for antimicrobial coatings. P4VP is reacted with 1,3-propane sultone to obtain a zwitterionic chemistry with a balanced surface charge that minimizes the interaction with and thus attachment from various microbes. Divinylbenzene (DVB) copolymerizes with 4VP and renders the copolymer resistant to the oxidation of chlorine. The simultaneous use of chlorine (an extremely potent antimicrobial agent) and the chlorine-resistant, antifouling coating achieves much greater fouling resistance than that if one assumes additive effects between chlorine and the coating (namely synergistic effect). Ultrathin P4VP coatings are put down on commercially available TFC membranes via iCVD. Since surface tension and de-wetting are avoided, this all-dry process conforms to the geometry of the underlying substrate.

Advantages

- Ease of application, excellent control (of both coating thickness and chemistry) and surface conformance via iCVD technique
- Solvent free and room temperature deposition process is unlikely to damage delicate RO membrane
- Zwitterionic copolymer film provides ultralow biofouling surface
- Chlorine-resistant coating enhances membrane maintenance

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Categories For This Invention:

Chemicals
Water Treatment
Desalination

Intellectual Property:

Antifouling and chlorine-resistant ultrathin coatings on reverse osmosis membranes
Issued US Patent

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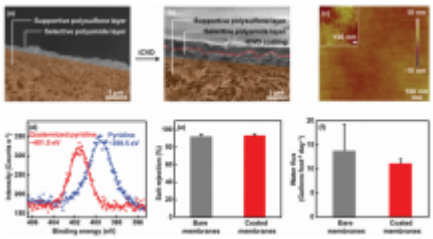
Publications:

Synergistic Prevention of Biofouling in Seawater Desalination by Zwitterionic Surfaces and Low-Level Chlorination
Advanced Materials
March 19, 2014
Synergistic Prevention of Biofouling in Seawater Desalination by Zwitterionic Surfaces and Low-Level Chlorination
Advanced Materials
2014

External Links:

G-Lab at MIT
http://web.mit.edu/gleason-lab/

Image Gallery:



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