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www.elsevier.com/locate/memsci

PII: S0376-7388(17)30737-8
DOI: http://dx.doi.org/10.1016/j.memsci.2017.06.033
Reference: MEMSCI15345

To appear in: *Journal of Membrane Science*

Received date: 15 March 2017
Revised date: 4 May 2017
Accepted date: 7 June 2017

Cite this article as: Wenwei Zhong, Jingwei Hou, Hao-Cheng Yang and Vicki Chen, Superhydrophobic membranes via facile bio-inspired mineralization fo vacuum membrane distillation, *Journal of Membrane Science* http://dx.doi.org/10.1016/j.memsci.2017.06.033

Superhydrophobic membranes via facile bio-inspired mineralization for vacuum membrane distillation

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Abstract

Growing interests have been shown on the application of vacuum membrane distillation (VMD) for desalination and concentrated effluent treatment due to its high mass transfer efficiency. However, VMD is more prone to severe membrane wetting, potentially due to the high-pressure difference across the membrane. Anti-wetting strategies such as frequent cleaning to remove the crystals and surface modification of the membrane to improve the intrinsic anti-wetting property are often investigated. The usual approach to enhance the surface hydrophobicity is to introduce a nanostructured surface or/and to reduce the surface energy by functionalisation. This work demonstrated a facile process to introduce a superhydrophobic layer on polypropylene hollow fiber membranes via a mussel-inspired modification technique. The membranes were deposited by polydopamine/polyethyleneimine, followed by the surface silicification and subsequent fluorination. We examined the surface morphologies, chemistry and wettability after each step of surface modification. The surface functional coating is ultrathin, which imposed a negligible effect on the membrane pore size. The final modified membranes exhibited comparable mass transfer with the virgin membrane, but superior wetting resistance in 35 g/L NaCl solution for long term operation with the permeate conductivity < 10 μS/cm for 50 h. It also showed excellent cleaning efficiency in the long-term treatment of brackish groundwater concentrate.

Graphical abstract