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High-performance polyamide thin-film-nanocomposite reverse osmosis membranes containing hydrophobic zeolitic imidazolate framework-8

Jintang Duan, Yichang Pan, Federico Pacheco, Eric Litwiller, Zhiping Lai, Ingo Pinnau*

Advanced Membranes and Porous Materials Center, Division of Physical Sciences and Engineering, King Abdullah University of Science and Technology (KAUST), Al-Jazri Bldg. 4, Thuwal 23955-6900, Saudi Arabia

*Corresponding author. Tel.: +966 12 808 2406.

E-mail address: ingo.pinnau@kaust.edu.sa (I. Pinnau)

Abstract

A hydrophobic, hydrothermally stable metal-organic framework (MOF) - zeolitic imidazolate framework-8 (ZIF-8) was successfully incorporated into the selective polyamide (PA) layer of thin-film nanocomposite (TFN) membranes for water desalination. The potential advantages of ZIF-8 over classic hydrophilic zeolite used in TFNs include: i) theoretically faster water transport within the framework and ii) better compatibility with the PA matrix. The TFN membranes were characterized with SEM, TEM, AFM, XPS, water contact angle measurements and reverse osmosis tests under 15.5 bar hydraulic pressure with 2000 ppm NaCl solution. Lab-made, nano-sized (~200 nm) ZIF-8 increased water permeance to 3.35±0.08 L/m^2·h·bar at 0.4 % (w/v) loading, 162 % higher than the pristine PA membranes; meanwhile, high NaCl rejection was maintained. The TFN surface was less crosslinked and more hydrophilic than that of the pristine PA. A filler encapsulation mechanism was proposed for the effects of filler on TFN membrane surface morphology and properties. This study experimentally verified the potential use of ZIF-8 in advanced TFN RO membranes.