Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2021.26967

218 (2021) 177–192
April

Interplay of graphene oxide and interfacial polymerized polyamide-crosslinked thin-film composite membranes for enhanced performance during reverse osmosis

Sanju Gupta[a,b,c,*], Brendan Evans[b,†]

[a]*Department of Chemistry and Biochemistry, The City College of New York-CUNY, 160 Convent Ave., New York, NY 10031, USA, email: sgup77@gmail.com (S. Gupta)*
[b]*Department of Physics and Astronomy, Western Kentucky University, 1906 College Heights Blvd., Bowling Green, KY 42101, USA, email: brendan.evans054@topper.wku.edu (B. Evans)*
[c]*Biotechnology Center, Western Kentucky University, 1906 College Heights Blvd., Bowling Green, KY 42101, USA*

Received 21 September 2020; Accepted 21 December 2020

ABSTRACT

Graphene oxide (GO) and its functionalized derivates are regarded as promising due to superior hydrophilicity, mechanical stability, and biocidal properties, which overcomes the inherent limitations of current polymer membranes. In this work, thin-film nanocomposite (TFNC) membranes with a thin polyamide (PA) active layer embedded in multifunctional poly tannic acid modified GO (here on, pTA-f-GO) through interfacial polymerization are developed as emergent reverse osmosis membranes with new multifunction. The introduction of varied GO loadings, that is, pTA-f-GOx, x = 0, 40, 80, 120, 200, and 500 μg mL^{-1}, provided a tunable chemical composition, hydrophilicity, surface, and physicochemical properties potentially reduce electrolyte concentration polarization determined following ion retention estimates. The surface morphology of membranes revealed Turin-like structures and complex intra- and inter-polymer chain crosslinking. The flow of water molecules (ultrafast permeability), efficient adsorption of charged species (mono vs. divalent ions preference), bactericidal ability, and chlorine resistance of membranes are reported. Briefly, the water flux is enhanced by 30% and salt rejection increased for divalent ions as compared with monovalent ion species and the optimized behavior is observed for nominal GO concentration, that is, pTA-f-GOx membranes with x = 80 and 120 μg mL^{-1}. The incorporation of optimal GO also contributed to significant chlorine resistance by 75% and bactericidal properties by 80%. This study overcomes the demand and supply gap of drinkable freshwater through nanotechnology-enabled graphene oxide-polymer TFNC membranes, display energy-efficient, and cost-effectiveness, which are invaluable for industrial plants.

Keywords: Graphene oxide; Interfacial polymerization; Reverse osmosis; Bactericidal; Chlorine resistance

* Corresponding author.
This work was performed while the corresponding author was at the Western Kentucky University.
Current address: Department of Chemistry and Biochemistry, The City College of New York-CUNY, 160 Convent Ave., New York, NY 10031, USA.

† The co-author is an undergraduate student researcher.