A green approach to modify surface properties of polyamide thin film composite membrane for improved antifouling resistance

Ying Siew Khoo[a], Woei Jye Lau[a], Yong Yeow Liang[b], Mustafa Karaman[c], Mehmet Gürsoy[c], Ahmad Fauzi Ismail[a]

[a] Advanced Membrane Technology Research Centre (AMTEC), Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia

[b] Faculty of Chemical and Process Engineering Technology, College of Engineering Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang, Malaysia

[c] Department of Chemical Engineering, Konya Technical University, Konya 42075, Turkey

ABSTRACT

A green approach based on plasma enhanced chemical vapour deposition (PECVD) method was adopted in this work to modify surface properties of thin film composite (TFC) membranes for improved antifouling resistance during desalination process. Two types of hydrophilic monomers, i.e., acrylic acid (AA) and 2-hydroxyethyl methacrylate (HEMA) was respectively deposited onto the surface of commercial TFC membranes (XLE and NF270) and the effect of plasma deposition time (15 s, 1 min and 5 min) on the membrane physiochemical properties was investigated using different analytical instruments. The deposition of AA and HEMA was able to improve the membrane hydrophilicity owing to the presence of hydroxyl and carboxyl functional groups. However, prolonged plasma polymerization period was not encouraged as it led to the formation of thicker skin layer that significantly reduced water permeability. With 15-s plasma deposition time, AA and HEMA-modified XLE and NF270 membranes could achieve higher NaCl and Na_2SO_4 rejections as well as demonstrate 100% flux recovery rate. The improved antifouling resistance of modified TFC membranes is mainly due to the improved surface hydrophilicity coupled with greater surface charge properties. This work demonstrated a rapid solvent-free surface modification method that can be employed to enhance TFC membrane properties for desalination process.

KEYWORDS

Surface modification; TFC membrane; PECVD; Hydrophilic monomers; Anti-fouling

ACKNOWLEDGEMENT

The authors are thankful to the Malaysia Ministry of Higher Education (MOHE) and the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC) for providing financial support under Fundamental Research Grant Scheme (R.J130000.7851.5F017) and International Collaboration Fund (R.J130000.7951.4S143), respectively.