

A comprehensive review on anti-fouling nanocomposite membranes for pressure driven membrane separation processes

Jainesh H. Jhaveri, Z.V.P. Murthy *

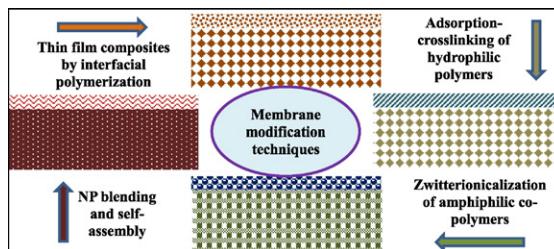
Department of Chemical Engineering, S. V. National Institute of Technology, Surat, India



HIGHLIGHTS

- Membrane fouling, due to hydrophobicity, is the main drawback of membrane processes.
- Polymer membranes can be modified by different methods to overcome membrane fouling.
- Interfacial polymerization, surface reaction, nanoparticle blending, etc. are used.
- Nanocomposite membranes by blending, sol-gel, self-assembly, etc. can be used.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 29 September 2015
Received in revised form 10 November 2015
Accepted 12 November 2015
Available online 18 November 2015

Keywords:

Nanofiltration
Nanocomposites
Anti-fouling
Hydrophilicity

ABSTRACT

The advantages of membrane technology over conventional separation methods are high removal capacity, flexibility of operation and cost effectiveness. However, the main limitation to the greater use of membrane technology is membrane fouling. Fouling is the phenomena of deposition or adsorption of colloids, particles, biomolecules and macromolecules (e.g. proteins, polysaccharides), salts, etc. on the membrane surface and/or inside pores and pore walls during filtration. This leads to a decline in permeation flux, change in selectivity and separability during filtration operation, and reduces membrane life. Various studies have concluded that intrinsic hydrophobicity of membrane materials is one of the main reasons for fouling. To overcome this drawback, various nanocomposite membranes are being tailored to impart certain properties such as hydrophilicity, anti-fouling, self-cleaning, photocatalytic, and photodegradation. This review is focused on the nanocomposite membranes that are made by incorporating nanoparticles (NPs) into polymeric membrane matrix by different methods like coating, blending, and deposition. Some of the nanocomposite membranes reported include metal-based NPs viz. TiO₂, SiO₂, Al₂O₃, Si, Ag, ZnO, ZrO₂, Mg(OH)₂, CaCO₃, and TiSiO₄; carbon-based NPs viz. graphene oxide (GO) and carbon nanotubes (CNTs); and NP composites viz. GO-SiO₂, GO-TiO₂, SiO₂-TiO₂, and Ag-SiO₂.

© 2015 Elsevier B.V. All rights reserved.

Contents

1. Introduction	139
1.1. Basics of membrane technology	139
1.2. Membrane preparation and modification	140
2. Nanocomposite membranes	140
2.1. Metal and metal oxide nanocomposite membranes	141
2.2. Carbon nanotechnology based membranes	142
2.3. Nanoparticle composite membranes	144
2.4. Application of metal organic frameworks in membrane processes	146

* Corresponding author.

E-mail addresses: zvpm2000@yahoo.com, zvpm@ched.svnit.ac.in (Z.V.P. Murthy).

3.	Characterization techniques	147
3.1.	SEM, EDX and XPS	147
3.2.	XRD and FT-IR	147
3.3.	TEM and DLS	148
3.4.	Contact angle	149
3.5.	AFM	150
3.6.	Other techniques – TGA, zeta potential, porosity, MWCO, TOC, UV spectrophotometer	150
4.	Conclusions and future scope	151
	References	151

Nomenclature

List of Abbreviations

3-BPA	3-bromopropionic acid
ABS	acrylonitrile butadiene styrene
AFM	Atomic Force Microscope
AIBN	Azo-bis-isobutyrylnitrile
ATR	Attenuated Total Reflectance
BET	Brunauer–Emmett–Teller
BPPO	Brominated polyphenylene oxide
BSA	Bovine Serum Albumin
CA	cellulose acetate
ca.	circa (meaning approximately)
CNTs	carbon nanotubes
CPVC	chlorinated PVC
CS	chitosan
DLS	Dynamic Light Scattering
DMAc	N,N'-dimethyl acetamide
DMF	N,N'-dimethyl formamide
DMSO	dimethyl sulfoxide
DOM	dissolved organic matter
DSC	Differential Scanning Calorimetry
ECH	epichloro hydrine
ED	Electro-dialysis
EDA	ethylene diamine
EDX	Energy Dispersive X-ray spectroscopy
EEM	Fluorescence–Excitation Emission Matrices
ELS	electrophoretic light scattering
EPS	extra-cellular polymeric substances
FT-IR	Fourier Transform-Infra red spectroscopy
GO	graphene oxide
GOx	glucose oxidase
GP	gas permeation
HEMA	2-hydroxyethyl methacrylate
HFBM	hexafluorobutyl methacrylate
ICIC	5-isocyanato-isophthaloyl chloride
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass spectroscopy
IP	interfacial polymerization
IU	Imidazolidinyl Urea
MF	microfiltration
ZIF-8	zeolitic imidazolate framework-8
MOFs	metal organic frameworks
MPD	m-phenylene diamine
MPDSAH	{3-(Methacryloylamino)propyl}-dimethyl(3-sulfopropyl)ammonium hydroxide
MPTES	3-mercaptopropyltriethoxysilane
MWCNT	multi-walled CNT
MWCO	molecular weight cut-off
NF	nanofiltration
NIPS	non-solvent induced phase separation

NMP	N-methyl-2-pyrrolidone
NMR	Nuclear Magnetic Resonance
NOCC	N,O-carboxy methyl chitosan
NOM	natural organic matter
NP(s)	nanoparticle(s)
OMWCNT	Oxidized MWCNT
OVA	ovalbumin
PA	polyamide
PAA	poly acrylic acid
PAN	polyacrylonitrile
PANI	polyaniline
PDMAEMA	poly(N,N-dimethylamino-2-ethylmethacrylate)
PE	Polyethylene
PEG	Polyethylene glycol
PEK-C	cardo-polyether ketone
PEO	Polyethylene oxide
PES	Polyether sulfone
PFOA	pentadecafluoroctanoic acid
PP	Polypropylene
PPO	Polypropylene oxide
PSf	polysulfone
PV	pervaporation
PVA	Polyvinyl alcohol
PVB	Poly (vinyl butyral)
PVC	Polyvinyl chloride
PVDF	Polyvinylidene fluoride
PVF	Polyvinyl formal
PVP	Poly vinyl pyrrolidone
rGO	reduced GO
RO	reverse osmosis
SEM	Scanning Electron Microscope
SMP	soluble microbial products
SOC	synthetic organic compound
SPES	Sulfonated PES
SWCNT	Single-walled CNT
TBPO	Tert-butyl peroxide
TBT	tetrabutyltitannate
TBZ	tetrabutyl zirconate
TEM	Transmission Electron Microscope
TEOS	tetraethoxysilane
TET	tetraethyltitannate
TETA	triethylene tetramine
TFC	thin film composite
TGA	Thermo-Gravimetric Analysis
THF	tetrahydrofuran
TIPS	thermally induced phase separation
TMC	Trimesoyl chloride
TOC	Total Organic Carbon
UF	ultrafiltration
XPS	X-ray Photo-electron spectroscopy
XRD	X-Ray Diffraction

Download English Version:

<https://daneshyari.com/en/article/622914>

Download Persian Version:

<https://daneshyari.com/article/622914>

Daneshyari.com