PVDF/PBSA membranes with strongly coupled phosphonium derivative and graphene oxide on the surface towards antibacterial and antifouling activities

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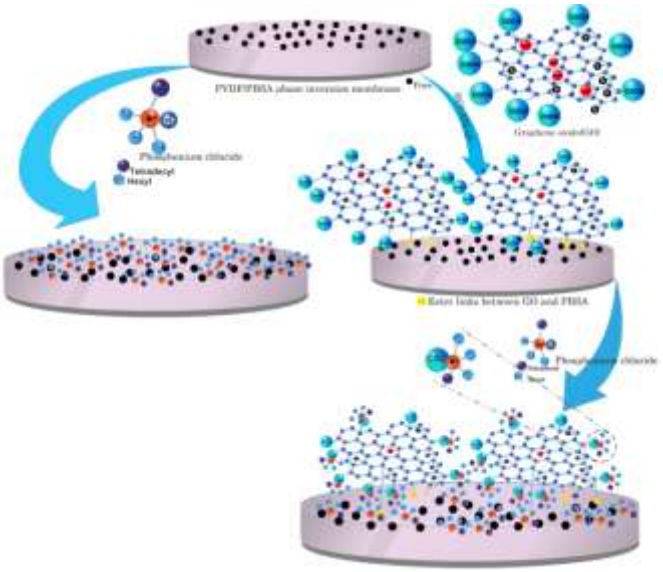
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Abstract

Poly (vinylidene fluoride) (PVDF) based membranes are inert and hydrophobic, which makes them susceptible to biofouling. Blending it with a biopolymer like Poly (butylene succinate-co-adipate) (PBSA) can offer functional sites to tether anti-microbial and anti-fouling agents to improvise the anti-bacterial and anti-fouling properties of PVDF. In this study porous PVDF/PBSA membranes were obtained using non-solvent induced phase separation and modified by a unique phosphonium chloride trihexyltetradecylphosphonium chloride (TPCl) by two approaches. In the first approach; phosphonium chloride was immobilized onto the porous membrane while in the second, the membrane was tethered with graphene oxide initially and then immobilized by phosphonium chloride leading to synergistic performance towards excellent antibacterial and antifouling characteristics. The antimicrobial action manifested by the modifications was assessed by standard plate count taking *E.coli* and *S.aureus* as model bacterial organisms. To understand the antimicrobial mechanism, outer membrane permeabilization studies with *N*-Phenyl-1-naphthylamine assay, intracellular leakage of K^+ ion and nucleic acids in metabolic pool and intracellular Reactive oxygen species (ROS) generation studies were assessed. The antifouling study was also carried out by using Bovine serum albumin (BSA) as a model biofoulant. This study demonstrated high distilled water flux, excellent fouling resistance, impressive 7-fold reduction of bacteria and stable flux performance.

Image



Recent Publications

1. Antibacterial and Antibiofouling Polymeric Membranes through Immobilization of Pyridine Derivative Leading to ROS Generation and Loss in Bacterial Membrane Integrity; PK Samantaray, G Madras, S Bose; Chemistry Select, DOI: 10.1002/slct.201701701
2. Selective cleavage of the polyphosphoester in crosslinked copper based nanogels: enhanced antibacterial performance through controlled release of copper; N Padmavathy, PK Samantaray, L D G, G Madras, S Bose; Nanoscale, DOI: 10.1039/C7NR02446K
3. PVDF/PBSA membranes with strongly coupled phosphonium derivatives and graphene oxide on the surface towards antibacterial and antifouling activities; PK Samantaray, G Madras, S Bose; Journal of Membrane Science, DOI: https://doi.org/10.1016/j.memsci.2017.11
4. Cationic biocide anchored graphene oxide based membranes for water purification; PK Samantaray, S Bose; Proceedings of Indian National Science Academy,(In press)



Biography

Paresh Kumar Samantaray is a 3rd year PhD student in the interdisciplinary Center for BioSystems Science and Engineering, Indian Institute of Science Bangalore under the guidance of Prof. Giridhar Madras and Prof. Suryasarathi Bose. He has a Bachelor's of Technology degree in Plastics Engineering from Central Institute of Plastics Engineering and Technology, Bhubaneswar and is currently working in the field of polymeric membranes for water purification. He likes to innovate and has developed an in-house cross flow setup with automated back flushing system to test the polymeric membrane efficiency. He is currently working on ecofriendly tailored antibacterial and antifouling engineering materials which can enhance the properties of polymeric membranes without compensating the flux and being low cytotoxic after use.

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