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Ultra-wetting graphene based ultrafiltration membranes for efficient wastewater treatment

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Graphene, an sp2-hybridized, two-dimensional carbon material is gaining much attention in the field of membrane science and engineering. Theoretical analysis have also predicted that graphene based membranes may exhibit orders of magnitude with greater permeability than the current state of the art membranes. However, most of these studies are based on a single layer of graphene sheet. Experimental studies also show that it is difficult to fabricate leak-free porous graphene membranes with large surface area. In this work, we report a facile method to fabricate graphene-based composite ultrafiltration membrane in real downstream application. In order to achieve this, the wettability of graphene was increased by amine and carboxyl functionalization. Graphene was first carboxylated, using highly concentrated acid mixture (hydrochloric acid and sulphuric acids). The carboxylic group was further modified to acid chloride. Finally, the acid chloride modified graphene oxide was amine functionalized by using ethylene diamine. The functionalized graphene oxide was then attached to a highly hydrophilic water insoluble polymer (poly-acrylonitrile-co maleic-anhydride). The graphene oxide grafted poly acrylonitrile co maleimide (G-PANCMI) was used to prepare the dope solution. The hollow fibre ultrafiltration membranes were prepared by dry wet spinning. The prepared membranes were characterized thoroughly and the experimental data indicates that the G-PANCMI play an important role in enhancing the hydrophilicity/ wettability, water permeability and selectivity of the PES UF membrane. The water contact angle (CAw) of the G-PANCMI modified PES membrane is reduced from 63.7±3.8° to 22.6±2.5° which is 64.5% reduction while, the permeability of the membrane increase to double. A long time filtration test was conducted using actual wastewater collected from the local wastewater treatment plant. The data shows that the novel ultra-wetting graphene based membrane can reduce the operating cost by up to 50% with its increased permeability and fouling resistance.

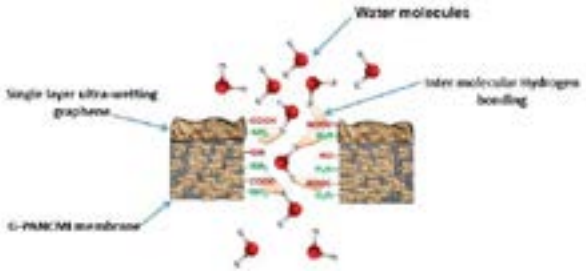

Figure 1: Schematic showing the principal behind the graphene water channels developed in this study

Biography

J Antony Prince received his PhD in Chemical Engineering and Advanced Materials at Newcastle University, UK. His main area of research interest is Membrane Technology and Applications. He has more than 10 years of research experience in Membrane Science and Engineering from both industrial and academic. He has secured more than SGD 6 million worth of projects from various funding agencies in Singapore. He has published his research findings in various reputed peer reviewed international journals and conferences. He has filed more than 10 patents. Two of his inventions have been licensed and a few patents are under evaluation for license. Since 2010, he has been with EWTCOI, Ngee Ann Polytechnic, Singapore, where he is currently the Senior Manager In-charge of Membrane Technology Section.

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