Functionalized Graphene Oxide Enabled Hybrid UF Membranes for Water Treatment

Hassan A. Arafat

Research and Innovation Center in Graphene and 2D Materials (RIC-2D), Khalifa University, Abu Dhabi, United Arab Emirate
E-mail: hassan.arafat@ku.ac.ae

Water scarcity challenges have been intensified by the ever-deteriorating freshwater resources worldwide. The demand of freshwater is mounting and, hence, it is anticipated that five billion people worldwide would suffer from water stress in 2050. This drives water treatment technologies, including membrane-based filtration processes [1-3]. A major challenge in membrane filtration is fouling which reduces the process performance. Fouling mostly happens due to the adhesion of foulants on the surfaces or within the pores of the membranes [3,4]. Thus, high performance membranes with superior fouling resistance are in demand to overcome the fouling problem encountered in surface water treatment. To achieve this goal, hybrid ultrafiltration membranes were manufactured using functionalized graphene oxide: sulfonated poly (ether ether ketone) polymer chains grafted graphene oxide (SPK-g-GO) or polydopamine-coated graphene oxide (PDGO), commercial poly(ether sulfone) and sulfonated poly (ether sulfone; SPES)) via the non-solvent induced phase separation (NIPS) method. All the membranes demonstrated typical asymmetric porous structures with a compact skin layer and porous sublayer with finger-like structure. These finger-like pores were elongated towards the bottom surface upon the integration of different wt.% functionalized GO. Hydrophilic and charge tunable hybrid UF membranes were finally produced. The rate of water penetration into the membranes matrix was tunable with the progressive addition of functionalized GO into the matrix of PES or SPES membranes. The hybrid membranes were tested in UF of humic acid and synthetic natural organic matter (NOM) solutions at 1.0 bar feed pressure. The membranes were competent in rejecting NOM in the feed solution. A remarkable improvement in fouling resistance efficacy of the hybrid membranes was observed during the cyclic filtration of NOM solution. Both reversible and irreversible fouling efficiency were significantly reduced with the loading amount of functionalized GO into the matrix of hybrid membranes. The synergic combinations of functionalized GO, PES or SPES were credited for the production of high-performance membranes with the stable fouling resistant. Tailor-made hybrid UF membranes can be easily produced via phase-inversion using this approach for efficient organics removal from contaminated surface water.

References

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