Light-Tunable Hybrid Ultrafiltration Membranes for Efficient Natural Organic Matter Removal from Municipal Wastewater

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Abstract

Natural organic matter (NOM) is widely recognized as the major contributor to fouling ultrafiltration processes yet remains difficult to control using conventional membranes[1,2,3]. In this work, we report light-responsive polyethersulfone membranes incorporating graphene oxide–azobenzene (GO-AZO) nanohybrids as an effective strategy to regulate NOM interactions. The covalent grafting of azobenzene onto graphene oxide introduces reversible cis–trans photoisomerization, allowing the membrane surface to dynamically alter wettability, charge distribution, and pore accessibility under alternating light exposure. Experiments with synthetic NOM demonstrate enhanced rejection and reduced irreversible adsorption, while extended operation with municipal wastewater confirms stable performance and recovery under realistic conditions. By combining tunable molecular responsiveness with graphene oxide reinforcement, this approach provides a scalable route to ultrafiltration membranes capable of managing NOM fouling in both controlled and complex environments, offering new opportunities for sustainable water purification technologies.

References

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