Novel MoS_2/GO/Chitosan Nanocomposite Membrane for Simultaneous Removal of Dye and Heavy Metal from Wastewater

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Abstract

Three distinct 2D MoS_2 morphologies—nanospheres (S-CM), nanoplatelets (P-CM), and nanosheets (T-CM)—were synthesized by tuning pH, concentration, and temperature and incorporated into chitosan to fabricate mixed matrix membranes. TEM confirmed the unique structures and crystallinity of each form. Among them, the P-CM membrane exhibited the highest heavy metal removal performance, removing 93.0 ± 0.5% Mn^{2+} and 90.4 ± 1.5% Zn^{2+} at a flux of 90.0 ± 3.0 $L/m^2 \cdot h$ [1]. Its superior activity was attributed to higher porosity and a defect-rich tri-layered MoS_2 structure, enabling H_2O_2 activation to generate reactive oxygen species (ROS). A 96.0 ± 0.5% flux recovery rate post-chemical cleaning confirmed strong regeneration capability.
Building on this, graphene oxide (GO) was then incorporated with P-CM to form an advanced nanocomposite membrane. This hybrid system achieved 95–100% color removal (UV-vis), complete TOC removal (100%) for methyl orange, and humic acid degradation of 99.9% (5 ppm) and 97.9% (10 ppm) [2]. It also removed >99% of methylene blue and Co^{2+}, with 89–96% rejection of Cu^{2+}, Pb^{2+}, and Ni^{2+}. ROS generation was validated using terephthalic acid trapping and fluorescence methods [3]. After four regeneration cycles, flux recovery remained >91%. These results demonstrate the promising potential of MoS_2-GO-chitosan membranes for robust and multifunctional treatment of complex wastewater streams.

References

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[2] Delal E. Al Momani, Fathima Arshad, Linda Zou, Environmental Technology & Innovation, 10 (2023) 3410-3428
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Figures

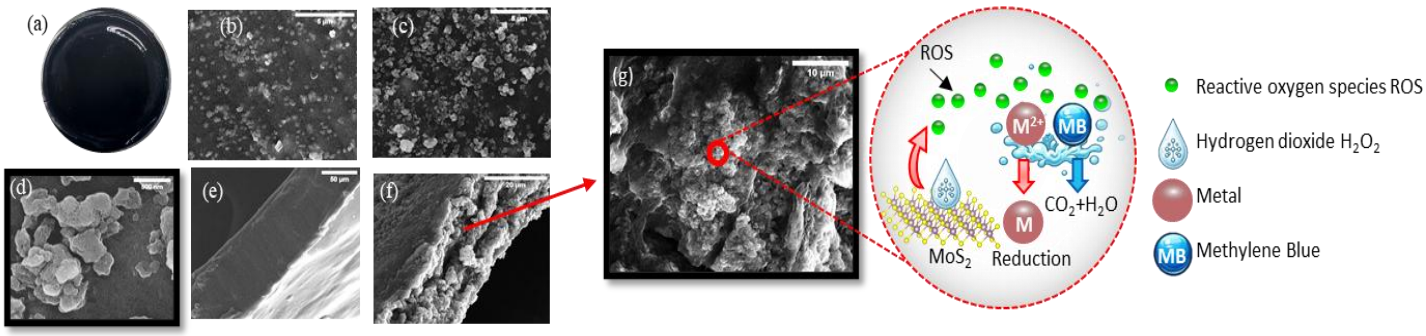

Figure 1: *(a) Fabricated membrane, SEM images: (b) Base, (c) Top surface, (d) Top surface Magnified View, (e) Cross-sectional view of neat Membrane, (f) Cross-sectional view of fabricated membrane, (g) Magnified view of fabricated membrane.*