Novel Heterostructured Holey Graphene-$CoTiO_3/TiO_2$ Nanocomposite Enabled Photocatalytic Mixed Matrix Membranes for Antibiotics Removal

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Discharging hospital wastewater without prior treatment is responsible for potentially transporting antibiotics-laden wastewater into water resources, which poses a significant threat to human health and the ecosystem [1,2]. To overcome this problem, photocatalysis and membrane filtration-enabled photocatalytic membrane reactors (PMRs) have emerged as a potential tool to remediate hospital wastewater and antibiotics contaminated water resources [3,4]. High photodegradation efficiency photocatalysts and advanced membranes are needed to develop photocatalytic membrane reactors. In this study, HGN-$CoTiO_3/TiO_2$ nanocomposites are first produced by integrating $CoTiO_3/TiO_2$ with 2D holey graphene (HGN), and sophisticated instrumental data validate the formation of HGN-$CoTiO_3/TiO_2$ nanocomposites. HGN-$CoTiO_3/TiO_2$ nanocomposites are proficient in the photocatalytic degradation of antibiotics aqueous solution over a short period of exposure to light radiation. The mixed matrix membranes (MMMs) with different loading of HGN-$CoTiO_3/TiO_2$ are also fabricated from HGN-$CoTiO_3/TiO_2$, PVP, and PVDF via the nonsolvent-induced phase separation method. All the membranes demonstrated typical asymmetric porous structures with a compact skin layer and porous sublayer with finger-like pores. The pure water flux, antifouling, and photocatalytic degradation efficiency are tunable upon varying the loading content of HGN-CoTiO3/TiO2 within the matrix of MMMs. The maximum pure water flux is observed for 5 wt.% HGN-$CoTiO_3$ incorporated membrane while the best antifouling and antibiotics photodegradation abilities are attained for 15 wt.% HGN-$CoTiO_3/TiO_2$ loaded membrane used in dead-end and vacuum filtration under direct exposure to light radiation. The integrated adsorption and photocatalytic membrane reactor can be manufactured using HGN-$CoTiO_3/TiO_2$ and MMMs for hospital wastewater treatment.

References

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Figures

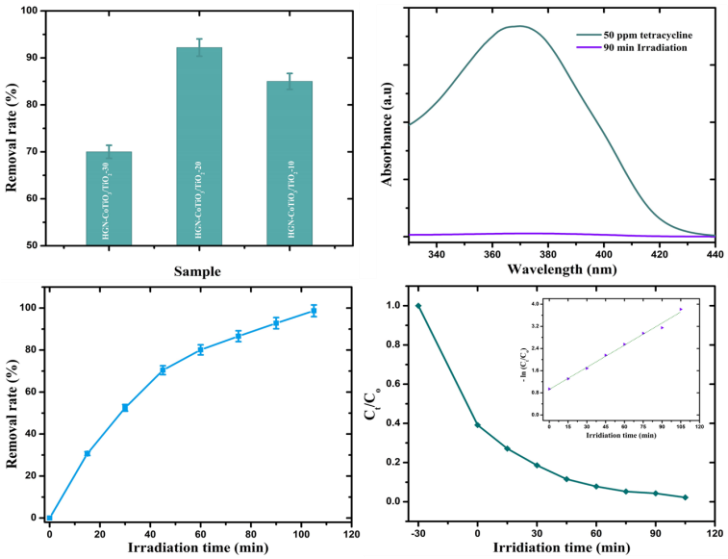

Figure 1: Photocatalytic performance of HGN-$CoTiO_3/TiO_2$ nanocomposite in degradation of antibiotic solution.