Title : The Development of Fermentation-Assisted Porous Sodium Alginate/Gelatin Hydrogel material and enhancing photocatalytic properties with Zinc Oxide

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ABSTRACT

A porous hydrogel based on sodium alginate and gelatin was developed using a microbial fermentation approach, in which carbon dioxide generated from yeast and glucose served as an internal pore-forming agent. The developed material was intended for environmental applications, particularly air pollution mitigation through particulate filtration. The optimal sodium alginate-to-gelatin ratio for hydrogel was investigated based on morphological characteristics observed by Scanning electron microscopy (SEM), physical appearance, and pore size analysis using ImageJ software. Among the examined formulations, a ratio of 3:5 exhibited the most favorable structural features, yielding an average pore size of 54.86 ± 2.26 μm with a interconnected porous network. The optimized hydrogel was further functionalized as a photocatalytic material through the incorporation of zinc oxide (ZnO) at various loadings. The presence and distribution of ZnO within the hydrogel matrix were confirmed by X-ray diffraction (XRD) and energy-dispersive X-ray spectroscopy (EDS) mapping. Preliminary photocatalytic performance was evaluated under ultraviolet irradiation through the degradation of Rhodamine B dye, demonstrating that the hydrogel containing the highest ZnO loading achieved a photodegradation efficiency of 45% after 10 h of irradiation. These results indicate that the fermentation-assisted porous hydrogel exhibits promising multifunctional properties and may provide a basis for further development in Particulate Matter Removal and related air pollution control applications.

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