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Topic of research: Synthesis, Characterization and Applicational Studies of Conducting Polymer Based Hydrogels

Findings

The thesis entitled "**Synthesis, Characterization and Applicational Studies of Conducting Polymer Based Hydrogels**" focuses on the development of conducting polymer-based hydrogels with dual functionality in controlled drug delivery and photocatalytic applications. Conducting polymers such as polypyrrole (PPy), polyaniline (PANI), poly(1-naphthylamine) (PNA), poly(o-phenylenediamine) (POPD), and polyvinylidene fluoride (PVDF) were synthesized and incorporated into hydrogel matrices to enhance their performance. Characterization techniques, including FTIR, XRD, SEM, DLS, rheology, and UV-Vis, were used to analyse their structural, morphological, and optical properties. In vitro drug release studies demonstrated that the inclusion of conducting polymers significantly improved controlled drug release, with POPD/Na-ALG-50 achieving the highest drug delivery efficiency at 99%. Additionally, the hydrogels exhibited pH-responsive behaviour, with greater drug release at pH 7.4 than at pH 1.2, confirming their suitability for targeted drug delivery. Furthermore, the photocatalytic activity of the xerogels was evaluated under UV-visible light, where PANI/PPy-2/1 xerogel exhibited maximum degradation efficiency, achieving 96% degradation of Alizarin Red S (ARS), 92% of Methyl Orange (MO), 88% of Rhodamine B (RhB), and 85% of Methylene Blue (MB). These findings highlight the potential of conducting polymer-based hydrogels as multifunctional materials for biomedical applications and environmental remediation, offering a promising platform for next-generation drug delivery systems and efficient pollutant degradation.