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Multifunctional Hydrogel Nanocomposite for on-demand Drug Delivery in Soft Tissue Cancer Treatment

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This research project focuses on the development of a multifunctional hydrogel nanocomposite for local drug delivery in the treatment of soft tissue cancer. The nanocomposite incorporates superparamagnetic iron oxide nanoparticles (SPIONs) within a thermoresponsive hydrogel matrix. The aim is to address critical limitations in current approaches to soft tissue cancer treatment by providing a functional platform that mimics the extracellular matrix (ECM) and allows precise control over drug release.

Comprehensive physicochemical analysis, including scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and thermogravimetric analysis (TGA), is conducted to characterize the properties of the nanocomposite and optimize its performance. An alternating magnetic field (AMF) is utilized to facilitate on-demand drug delivery, while also enabling investigation into the thermal effects on tissue regeneration mechanisms.

The proposed system offers promising potential for improved soft tissue cancer regeneration, with tailored mechanical properties and enhanced drug delivery capabilities. This interdisciplinary research bridges materials engineering with clinical practice, aiming to advance therapeutic solutions for soft tissue cancer treatment. The novelty of this work lies in the integration of thermoresponsive hydrogels with nanostructural heat generators, presenting a novel approach to soft tissue cancer regeneration. This study contributes valuable insights to the field of biomaterials science and holds implications for the development of future therapeutic strategies.