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CHARACTERZATION OF POLY(N-IZOPROPYLACRYLAMIDE) HYDROGEL NANOCOMPOSITES INFLUENCED BY ANIZOTROPIC SILVER NANOPARTICLES

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Abstract

Hydrogels possess distinctive characteristics that can be tailored to meet specific needs, especially in the field of biosciences, which is continuously expanding and advancing. Adjustability of gel porosity, followed by tunability of swelling properties, environmental responsiveness, and stability, are properties that are easily adjusted, offering researchers and engineers the flexibility to fine-tune these properties to suit the specific requirements of diverse applications. As a result of environmental responsivity, one class of these materials emerged, referred to as stimuli-responsive or smart hydrogels. Such hydrogels can change their properties in response to specific external stimuli or environmental conditions in a controlled and reversible manner. Depending on the specific type of smart hydrogel, this feature can enable targeted drug delivery, tissue engineering, and controlled release systems while maintaining their biocompatibility. Poly(N-isopropylacrylamide) (PNiPAAm) is a thermosensitive polymer with a well-defined volume phase transition temperature (VPTT) around 32°C. Conversely, silver nanoparticles (AgNPs) continue to preserve academic interest due to their size-dependent optical, catalytic, and electronic properties, as well as their significant antimicrobial potential. One of the primary obstacles encountered by scientists is establishing the broader range of practical applications of AgNPs as well as improving the existing ones. Optimizing their properties often involves controlling size and shape, stability, and surface properties. In order to determine how anizotropic Ag NPs alter and influence the physicochemical properties of PNiPAAm we present a simple, straightforward two-step synthesis of AgNPs/PNiPAAm hydrogel nanocomposites. This method involves the chemical synthesis of both spherical and triangular AgNPs, followed by the crosslinking of PNiPAAm through gamma irradiation in the presence of nanoparticles. The validation of employing gamma irradiation is based on the fact that this technology integrates the processes of sterilization and synthesis, resulting in a consolidated technical step that enhances efficiency and enables the exploration of numerous innovative biomedical applications. The porous sponge-like structure was observed by SEM analysis, while the formation of stable and uniformly distributed AgNPs in the polymer was confirmed by UV-VIS spectroscopy. Swelling and deswelling processes were performed in water at 25°C and 48°C, respectively. In addition, AgNPs were shown to influence VPTT values. The primary objective of this study is to examine the correlation between various morphologies of AgNPs and the physicochemical characteristics of nanocomposite samples. This investigation considers the possible uses and the current demand for the extensive utilization of biocompatible materials.

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