World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:11, No:04, 2017

Clay Hydrogel Nanocomposite for Controlled Small Molecule Release

Authors : Xiaolin Li, Terence Turney, John Forsythe, Bryce Feltis, Paul Wright, Vinh Truong, Will Gates

Abstract : Clay-hydrogel nanocomposites have attracted great attention recently, mainly because of their enhanced mechanical properties and ease of fabrication. Moreover, the unique platelet structure of clay nanoparticles enables the incorporation of bioactive molecules, such as proteins or drugs, through ion exchange, adsorption or intercalation. This study seeks to improve the mechanical and rheological properties of a novel hydrogel system, copolymerized from a tetrapodal polyethylene glycol (PEG) thiol and a linear, triblock PEG-PPG-PEG (PPG: polypropylene glycol) α,ω-bispropynoate polymer, with the simultaneous incorporation of various amounts of Na-saturated, montmorillonite clay (MMT) platelets (av. lateral dimension = 200 nm), to form a bioactive three-dimensional network. Although the parent hydrogel has controlled swelling ability and its PEG groups have good affinity for the clay platelets, it suffers from poor mechanical stability and is currently unsuitable for potential applications. Nanocomposite hydrogels containing 4wt% MMT showed a twelve-fold enhancement in compressive strength, reaching 0.75MPa, and also a three-fold acceleration in gelation time, when compared with the parent hydrogel. Interestingly, clay nanoplatelet incorporation into the hydrogel slowed down the rate of its dehydration in air. Preliminary results showed that protein binding by the MMT varied with the nature of the protein, as horseradish peroxidase (HRP) was more strongly bound than bovine serum albumin. The HRP was no longer active when bound, presumably as a result of extensive structural refolding. Further work is being undertaken to assess protein binding behaviour within the nanocomposite hydrogel for potential diabetic wound healing applications.

Keywords : hydrogel, nanocomposite, small molecule, wound healing
Conference Title : ICBBE 2017 : International Conference on Bioengineering and Biomedical Engineering
Conference Location : Lisbon, Portugal
Conference Dates : April 16-17, 2017