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Biopolymer Congress 2018: Electromachanical and creep behavior of pullulan hydrogels: Effects of amount of crosslinking agent and electric field strength

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Pullulan is one of the nonionic polysaccharides derived from the fermentation medium of black yeast. Because of their non-toxic, non-mutagenic, non-immunogenic, non-carcinogenic, and odorless properties, they have been investigated for biomedical applications, including tissue engineering, targeted drug / gene delivery, and wound healing. In addition, Pullulan is an interesting material for the development of a new polymer actuator with improved existing trigger properties. In this work, the pulp was prepared using sodium trimetaphosphate (STMP) as a crosslinking agent for hydrogel formation. The effects of crosslinking quantities and electric field strength on electromechanical properties are investigated. The storage modulus (G ') increased with increasing amount of crosslinking agent. Due to the electric field strength effect, the storage module decreased at low electric field strength. On the other hand, the storage module increased at high electric field strength. in addition, the storage module and loss modules were changed to creep compliance through the release spectrum and the lag spectrum. Compliance with the Pulane hydrogel decreased with increasing amount of crosslinking agent. In the case of electric field strength, the creep compliance initially increased at low electric field strength and decreased at high electric field strength, indicating that two competing mechanisms are involved.

An electric field surrounds an electric charge. Electric and magnetic fields are a manifestation of an electromagnetic force, one of the four basic forces (or interactions) of nature. Electric fields are important in many areas of physics and are exploited practically in electrical engineering. The SI unit for electric field is volt per meter (V / m), which corresponds to the Newton equivalent per coulomb (N / C) in the SI system. The basic theory of a new drive concept based on hydrogel core matrix composites (H-FMC) is presented. A key principle that emphasizes the operation of the H-FMC drive is that the three-dimensional swelling of the hydrogel is partially limited to improve the amount of useful work. The partial limitation applies to the hydrogel with a flexible matrix composition (FMC) that reduces the volume expansion of the hydrogel while it swells. This limitation serves to increase the fixed charge density and the consequent osmotic pressure, which is the driving force for activation. In addition, for some FMC fiber orientations, the Poisson ratio of the anisotropic FMC laminate converts previously unused hydrogel swelling in the radial and circumferential directions into useful axial strains. The potential benefit of the H-FMC concept in terms of hydrogel drive performance is demonstrated by comparing force curves - and evaluating improvements in usable actuation work. The model used to achieve these pairs of chemical and electrical components is represented by Nernst Planck and Poisson equations, as well as a linear elastic mechanical material involving bounded geometric nonlinearities. The H-FMC concept has been found to achieve usable drive improvements of 1500% compared to bare hydrogel performance. A parametric study is also performed to determine the influence of different FMC design parameters on the trigger-free load and voltage blocking. A comparison with other drive concepts is also included. (paper).

Epidermal pH is a sign of the physiological state of the skin. For example, wound pH can be associated with angiogenesis, protease activity, bacterial infection, and so on. Chronic incurable wounds are known to have an elevated alkaline environment, while the healing process takes

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place more easily in an acidic environment. Thus, dermal patches that are capable of continuous pH measurement can be used as a care system to monitor skin diseases and the wound healing process. Here, pH-responsive hydrogel fibers are presented that can be used for long-term monitoring of the condition of the epidermis. Dyes that respond to pH are loaded into mesoporous microparticles and incorporated into hydrogel fibers using a microfluidic spinning system. Manufactured microfibers that are responsive to pH are flexible and can create an even contact with the skin. The response of pH-sensitive fibers with different compositions and thicknesses is characteristic. The proposed technique is extensive and can be used to make hydrogel-based wound dressings with clinically relevant dimensions. Images of pH sensing fibers during real-time pH measurement can be captured with a smart camera for convenient on-site reading. With the help of image processing, it is possible to extract a quantitative pH map of hydrogel fibers and underlying tissue. A developed skin dressing can act as an aid to monitor the wound healing process.

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