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Research paper

Mechanical properties and thermal behaviour of PEGDMA hydrogels for potential bone regeneration application

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ABSTRACT

Poly(ethylene glycol) hydrogels are currently under investigation as possible scaffold materials for bone regeneration. The main purpose of this research was to analyse the mechanical properties and thermal behaviour of novel photopolymerised poly(ethylene glycol) dimethacrylate (PEGDMA) based hydrogels. The effect of varying macromolecular monomer concentration, molecular weight and water content on the properties of the resultant hydrogel was apparent. For example, rheological findings showed that storage modulus (G′) of the hydrogels could be tailored to a range between approximately 14,000 and 70,000 Pa by manipulating both of the aforementioned criteria. Equally striking variations in mechanical performance were observed using uniaxial tensile testing where reduction in PEGDMA content in the hydrogels resulted in decrease in both tensile strength and Young's modulus values. Conversely, increases in the elongation at break values were observed as would be expected. Differential scanning calorimetry and dynamic mechanical thermal analysis showed that there was an increase in *Tg* with an increase in the molecular weight of PEGDMA. The relationship between the initial feed ratio, molecular weight of the macromolecular monomer and the subsequent mechanical properties of the hydrogels are further elucidated throughout this study.

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1. Introduction

Tissue engineering is the method of replicating tissue by using principles of engineering, medicine and physical sciences (Langer and Vacanti, 1993). Recently, this area of research has received extensive investigation in the literature and is of particular interest for bone regeneration applications. Bone has the ability to repair itself, however the rate and amount of repair are dependent on the actual size of the defect (Muschler and Lane, 1992). Defects of a size that

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