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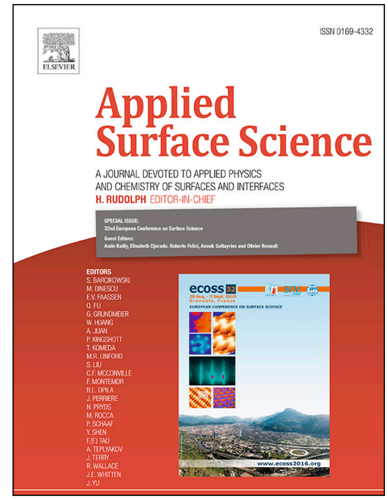

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Effects of the glycerophosphate-polylactic copolymer formation on electrospun fibers

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Abstract

Poly-lactic (PLA) porous fibers are widely used in tissue engineering scaffolds and many other fields. Non-solvent induced phase separation is one of the best way for preparation of porous fiber. It is difficult to obtain the PLA electrospun porous fibers by phase separation. In this paper, glycerophosphate-polylactic copolymer (GP-PLA) are synthesized with sodium glyceryl phosphate and L-lactide to produce porous fibers. Furthermore, the Gel permeation chromatography (GPC), FT-IR and ^{1}H-NMR are applied for characterizing the obtained copolymers. Thermogravimetric (TG) measurements indicate that the thermal stability of GP-PLA is lower than that of linear PLA. Under 30% humidity, porous GP-PLA fibers are obtained by electrospinning method, the scanning electron microscopy (SEM) refers that through the modification of the molecular structure, GP-PLA fibers are more porous under the same condition. The water contact angle is increased coming with the increase of GP contents. Hydrophilic porous GP-PLA fibers are obtained via solvent phase separation. The relationship between hydrophilicity and surface morphology of materials is further explained by Atomic Force Microscope (AFM). GP-PLA has a potential application in the field of scaffold for tissue engineering.

Keywords

Polylactide; Phospholipid; Electrospinning; Porous; Hydrophilicity

1. Introduction

Polylactic acid (PLA) is a renewable and biodegradable biopolymer[1-3], which derives from natural organic matter such as starch[3,4]. These polysaccharide compounds are converted into lactic acid by enzymatic reactions[5]. Actic acid construct PLA via chemical reaction such as ring opening polymerization(ROP) of lactides (i.e. cyclic dimers of lactic acid)[6-8], which is by direct condensation polymerization or azeotropic dehydration condensation. Due to its low toxicity[9,10], PLA-based polymers are widely used as important biological materials [11-13]. In addition, it can be processed into biomimetic moulded parts, mats or fibers [14,15]. As a result, PLA-based polymers attract an increasing interest in drug delivery systems[16], tissue engineering[17,18], and wound dressing[19] etc. However, the poor hydrophilicity nature of PLA often limits its usage[20]. The hydrophilicity of the material is very important to cell affinity. Currently, hydrophilic coating or constructing nano-porous structure on its surface are effective ways to improve the affinity of PLA-based polymers to the cells [21,22].

Porous PLA electrospun fibers are the pore structure at the nanoscale in fibers, which has recently received widespread concern[23,24]. Electrospinning is widely used to prepare nanofibers. Many protocols, such as phase separation, non-solvent induced phase separation, inorganic addition, coaxial electrospinning, particles leaching, etc [25-27] have been developed to construct nanoporous structure in the electrospun nanofibers. Solvent phase separation is a common method for getting nanoporous fiber. In solvent phase separation protocol, PLA molecules are dissolved in a mixed solvent system to form a spinning solution [28]. During spinning, one of the phase separation principles is called breath principle induced porosity [28, 29]. PLA is dissolved in a solution system composed of good solvents and non-solvents. Due to the non-solvent evaporation of solvents, pores are formed in the thermodynamically unstable PLA-riched phase. Although highly porous nanofibers can be prepared, the complex recipe and poor stability of spinning solutions are always challenging. Another principle of phase separation is vapour induced phase separation (VIPS) [30]. Solution of polylactic acid must have hydrophilic

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