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Biodegradable polyesters for biomedical applications: Alternatives to polylactides and polylactones

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Today's medicine requires bio-absorbable polymeric biomaterials that present thermoplastic elastomer (TPE) behavior, for their application as medical devices or scaffolds for soft tissue engineering. Among the most investigated polymers used as biomaterials, poly (glycolic acid) (PGA) and poly (lactic acid) (PLA) can be mentioned. These polyesters are however glassy at body temperature and mechanically brittle, so copolymerization with other monomers is a strategy to obtain TPEs with tuned biodegradation rate and mechanical properties. In a search of new polymeric biomaterials with TPE behavior, various lactones and macro lactones, most of them were employed previously by the chemical industry and cosmetics, which draw our attention. Among the cyclic esters, the following ones can be mentioned: β-propiolactone (β-PL), γ-butyrolactone (γ-BL), γ-valerolactone (γ-VL), δ-valerolactone (δ-VL), δ-methyl-ε-caprolactone, decalactones such as γ-decalactone (γ-DL), δ-decalactone (δ-DL) or ε-decalactone (ε-DL) (with rings of 5, 6 or 7 members respectively), ω-pentadecalactone (PDL), hexadecalactone or ethylene brassylate. Moreover, p-dioxanone or trimethylene carbonate may also be of interest. The mentioned substances are monomers that can be synthesized by ring opening polymerization on their own or on the dimmer (lactide and glycolide). In this work TPE copolymers of either high glass transition temperature (Tg) (>20ºC) or low Tg (between -65 and 0ºC) are synthesized and characterized in terms of molecular parameters, physical, chemical and mechanical properties and biodegradation. In the former case, copolymers of lactide with other co-monomers are proposed in order to reduce the melt temperature and crystallization capability of polylactide. In the latter, alternative copolymers will be introduced for poly (ε-caprolactone). This is because polymers of high Tg present low ductility, brittleness and too high stiffness for soft tissue applications. Those of low Tg, however, though excellent in the combination of mechanical properties for soft tissue engineering and devices, present often too low biodegradation rates.

Biography

Jose R Sarasua is Professor of Materials Science at the Department of Mining-Metallurgy Engineering and Materials Science, Faculty of Engineering of Bilbao, the University of the Basque Country (UPV/EHU). He is the Principal Investigator of the ZIBIO group on Science and Engineering of Polymeric Biomaterials and Member of POLYMAT, the Basque Center for Macromolecular Design and Engineering. His research interests are focused on the synthesis, structure and properties of polymeric biomaterials for medical applications.

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