SYNTHESIS AND CHARACTERIZATION OF POLYESTERS MODIFIED WITH CITRIC ACID AND PDMS

Kamilė Vonžodaitė, Saulutė Budrienė

Department of Polymer chemistry, Vilnius University, Naugarduko 24, LT-03225 Vilnius, Lithuania
E-mail: kamile.vonzodaite@chgf.stud.vu.lt

Polyesters are used in tissue engineering industry due to their biodegradability and biocompatibility. However, research for an overall easy to produce biocompatible and non-toxic elastomer with suitable mechanical properties is on-going [1]. Polydimethylsiloxane (PDMS) has been used in the industry for its transparency, easy manufacturing and low cost, but its application is limited due to hydrophobicity and poor mechanical properties. While PDMS surface can be modified to increase hydrophilicity, it is, usually, a short-term solution [2, 3]. These drawbacks could be counteracted by increasing polyester functionality with addition of PDMS and citric acid.

In this study, polyester was produced by two-step method. In the first step, polycondensation reaction between azelaic acid, maleic acid anhydride and diethylene glycol was carried out. Afterwards, α,ω-dihydroxy-polydimethylsiloxane and citric acid were added. Structure of obtained polyesters was evaluated by FT-IR and ^{1}H NMR spectroscopy. Films from modified polyesters were produced by adding curing agents: glycidyl methacrylate, butyl methacrylate and/or hydroxyethyl methacrylate together with photo initiator 2,2-dimethoxy-2-phenylacetophenone and curing under UV light. Cured films were analyzed by FT-IR spectroscopy. Solubility and degree of swelling in three different solvents: hexane, ethanol and water were determined for all produced films. Solubility and degree of swelling was the highest in ethanol and the lowest in hexane. After solubility test, elemental analysis of cured films was used to determine amount of silicon, which ranged from 1.5 to 2.3 %, depending on synthesis and curing conditions. This proved, that PDMS was present in formed polyester and films, too. The effects of molar ratios of initial materials and hardening agents (based on maleic acid anhydride) on wettability and mechanical properties of films were investigated. Water contact angle ranged from 77º to 97º and was lower than for commercial PDMS (>100º) [4]. Elongation at break ranged from 48 to 65 %. It decreased with increasing amount of citric acid and the best results were obtained when hardening agents glycidyl methacrylate and butyl methacrylate were used. Produced films showed good mechanical properties. Young's module ranged from 6 to 26 MPa. Thermogravimetric analysis showed that films were thermally stable, and degradation occurred in a two-step process, starting at 150 ºC. During the first step of degradation, cross-linked structure was broken up and linear macromolecules were obtained. During the second step, macromolecules were broken up into smaller fragments due to decomposition of ester bonds and PDMS segments. Glass transition temperature of films was determined by DSC method and ranged from -6º to 11º for first heating and from 4º to 15º for second heating.

References

1. Ye. H., Zhang, K. D. Kai, Z. Li, X. Loh. Chem. Soc. Rev. **47**, 12 (2018) 4545–4580.
2. Y. Chuah, Y. Koh, K. Lim, N. Menon, Y. Wu, Y, Kang. Sci Rep **5** (2016) 18162.
3. S. H. Tan, N.-T. Nguyen, Y. C. Chua, T. G. Kang. Biomicrofluidics. **4**, 3 (2010) 32204.
4. T. Trantidou, Y. Elani, E. Parsons, O. Ces. Microsyst. Nanoeng. **3** (2017) 16091.