BIOLOGICAL PROPERTIES OF ELASTOMERIC PHOTOCURED NETWORKS

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Introduction

Over the past years, significant attention has been paid to biocompatible and bioresorbable polymer networks, which are the preferred replacements for individual stable biomaterials used in medical applications [1-2]. One of the modern methods of crosslinking is photopolymerization, through which liquid monomers turn into a highly cross-linked polymer in seconds. This technique is economical, does not require toxic solvents, high temperature or pressure, and allows precise control of the reaction by the light source and fast crosslinking rates. Mild reaction conditions enable preparing materials in situ, *in vivo* with potential applications in tissue engineering or implantology. Despite many advantages offered by photoinduced polymerization, there are several factors that can limit its effectiveness. One of them is oxygen inhibition, which leads to formation of a layer of non-crosslinked monomer on the material surface [3].
In this paper, we investigated the effect of the cross-linking atmosphere and the addition of a reactive cross-linker (tripropyleneglycol diacrylate (TPGDA)) on the properties of the elastomeric polymer networks obtained from a telechelic precursor comprising terminal methacrylic functionalities on a uretane-ester backbone. *In vitro* cell culture tests were performed to assess cell response to extracts from the tested materials. In order to investigate stability of the polymer network, hydrolytic and enzymatic degradation has been performed.

Materials and Methods

Telechelic precursors comprising terminal methacrylic functionalities and ester-urethane derivatives of dimer fatty acids were used to obtain elastomeric polymer networks according the procedure described in [2]. The chemical structure of the precursor was assessed by ATR-FTIR analysis, confirming the presence of ester and urethane bonds. Polymer networks were obtained *via* photopolymerization according to the following scheme (FIG. 1).

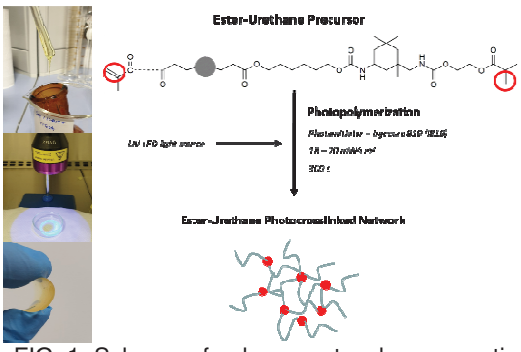

FIG. 1. Scheme of polymer networks preparation.

The crosslinking process was carried out in air or under argon. Cytotoxicity tests were performed on extracts of materials prepared with and without 25% wt. addition of TPGDA crosslinker, both in air and under argon. Polylactide (PLA, Resomer L210) and poly(ε-caprolactone) (PCL, CAPA 6430) were used as reference materials. Hydrolytic degradation of polymer networks (air atmosphere, 2% wt. I819, UVA 365 nm) was carried out in SBF solution at 37°C for 6 months.
Enzymatic degradation of polymer networks (argon, 25% wt. TPGDA, 1,5% I819, UVA 365 nm) was induced using lipase from *Pseudomonass cepacia* and carried out at 37°C for 42 days.

Results and Discussion

Cytotoxicity studies indicated that the crosslinking atmosphere and addition of reactive crosslinker (TPGDA) had a noticable effect on the viability of mouse fibroblast cells L929. Cells exposed to extracts of materials crosslinked under argon maintained a viability of ~90%, while extracts of same materials crosslinked in air were highly cytotoxic. (FIG. 2).

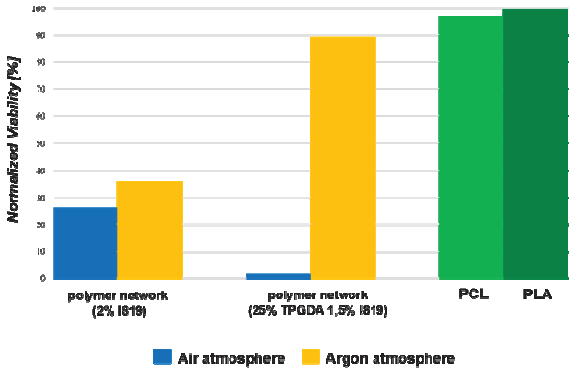

FIG. 2. Normalized viability of L929 cells in the presence of extracts from the tested materials.

The degradation studies, including mass loss measurements, showed that the materials are susceptible to both hydrolytic and enzymatic degradation. FTIR analysis identified changes in the functional groups present in the material structure. The most visible changes were observed in spectral features assigned to ester and urethane groups.

Conclusions

Ester-urethane polymer networks can be synthesized from telechelic macromonomers containing dimer fatty acids derivatives *via* photopolymerization. Cytotoxicity tests indicated that the combination of inert gas atmosphere present during crosslinking and the addition of a reactive crosslinker (TPGDA) yield a material that exhibits minimal cytotoxicity to L929 mouse fibroblast cells. Extracts from samples crosslinked in air exhibited relatively high cytotoxicity, likely due to oxygen inhibition, which results in a layer of unreacted monomer on the surface of the material and from which cytotoxic substances are release. The crosslinked materials were susceptible to hydrolytic and enzymatic degradation, as evidenced by registered changes in chemical structure and weight loss.

Acknowledgments

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