UV-CURED FILMS FROM POLYESTERS MODIFIED WITH α,ω -DIHYDROXY-POLY(DIMETHYLSILOXANE)

S. Gailiūnaitė*, L. Navickaitė, T. Kochanė, S. Budrienė
Vilnius University, Faculty of Chemistry and Geosciences, Institute of Chemistry, Naugarduko 24, 03225 Vilnius, Lithuania
**E-mail: sonata.gailiunaite@chgf.stud.vu.lt*

Tissue engineering is rapidly developing field that aims at creating functional constructs that mimic the properties of the extracellular matrix of the native tissues. It has become a promising approach to cure a number of diseases, damaged tissues or organs [1]. The tissues are grown on a synthetic artificial carcass which is created using UV-curing. It is very important to choose the right materials for the frame, it must be biocompatible, so that the cells could reproduce and functionalize, it must have mechanical strength, be flexible, biodegradable, easy to process and non-toxic [2]. Poly(dimethylsiloxane) (PDMS) elastomer is one of those biocompatible polymers due to its properties such as: non-toxicity, biocompatibility, gas permeability, thermal stability, chemical and biological inertness. However, its use is limited by hydrophobicity which can cause cellular adhesion on the surface to be short-lived, abrasion in the body and low mechanical resistance. PDMS could be modified to improve hydrophilicity, and then the ability to use PDMS significantly enhanced [3]. One of the possible modification methods is polyesters modification by hydroxyl terminated PDMS.

Polyester films were synthesized from azelaic acid (AA), maleic anhydride (MA), diethylene glycol and were chemically modified with hydroxyl terminated PDMS, at various initial molar ratios. Glycidyl methacrylate (GMA), buthyl methacrylate (BMA) and/or 2-hydroxyethyl methacrylate (HEMA) were used as curing agents to obtain UV-curable films. Resins were cured by free-radical polymerization using initiator Irgacure 651 and UV light. Chemical structure of films was investigated by FTIR, H^1 NMR and EDS. The films were tested for swelling degree and solubility in hexane, ethanol and water. Films with higher concentration of acelaic acid were less souluble in hexane, that's means that PDMS incorporation in polymer was better when acelaic acid concentration was higher. The films were less soluble in ethanol when amount of maleic anhydride was higher, because there is larger number of double bonds in the polyester chain. The films with higher amount of maleic anhydride swelled less in ethanol. High film swelling degree in both ethanol and water was obtained when HEMA was used for UV curing because of it is able to absorb large amounts of water due to the hydrophilic group. The amount of Si in cured films varied in the range from 0,6 % to 8,3 % and was higher when films were synthesized with higher amount of azelaic acid. Obtained films exhibit good wettability in comparison to commercial PDMS film (Sylgard 184), their water contact angle was lower (76.7-77.6°) than obtained in the Sylgard 184 case (101°). The resulting films have high surface porosity. Obtained pores size is in the range of 130-330 μm. The mechanical properties of the films were also measured by tensile test. Elongation at break (X_R) data suggest that elastic films were obtained using a mixture of GMA and BMA as additives when [AA]: [MA] = 0.3:0.2; 0.25:0.25 and 0.2:0.3, X_R ranges from 120 % to 320 %, which means that X_R was 4-11 times higher than commercial PDMS.

References

1. A. M.J.Coenena, et. al., Acta Biomaterialia 79, (2018) 60-82.
2. C. Yu et. al., Biomaterials 194, (2019) 1-13.
3. B.Y. Yoo et. al., Acta Biomaterialia 76, (2018) 56-70.