UV curable polyurethane acrylated resins as photoprintable biomaterial

C. Mendes-Felipe[1,2], **L. Ruiz-Rubio[1,2],** S. Lanceros[1,3], J.L. Vilas-Vilela[1,2]

[1]BCMaterials, Basque Center for Materials, Applications and Nanostructures, Leioa, Spain.
[2]Macromolecular Chemistry Group (LABQUIMAC), Leioa, Spain.
[3]IKERBASQUE, Basque Foundation for Science, Bilbao, Spain.
*E-mail: leire.ruiz@ehu.eus

Printable flexible biomaterials are considered highly valuable materials for development of additive manufacturing based medical devices. In this context, UV radiation-curable resins have arisen as a promising source of materials. However, the commercially available inks often present biocompatibility problems or even cytotoxicity. Thus, the development of biocompatible and printable resins could be an excellent approach for advanced flexible biomedical devices. Among the possible resins used in this area, polyurethane acrylate derivatives present highly interesting properties. They are solvent-free materials, being considered green resins, and require low energy for curing compared to other conventional thermocurable products. Furthermore, photopolymerization or UV curing process is faster and obtains better patterns (for 3D printing applications)[1].

Acrylate urethanes could combine the properties of polyacrylates (good optical properties and wettability, among others) with those of polyurethanes such as high abrasion resistance, toughness and tear strength [2].

A wide range of methods exists to obtain acrylated urethane UV curable materials, being the most important the combination of a polyol with an isocyanate and the addition of an alcohol-terminated acrylate. In this study, polycaprolactone triol (PCLT), IPDI and different alcohol-terminated acrylates such as hydroxyethylacrylate (HEA) and hydroxytehylmethacrylate (HEMA) are used to obtain polyurethane acrylate (PUA) and polyurethane methacrylate (PUMA) oligomers, respectively. Fourier Transformed Infrared Spectroscopy (FTIR) is used to follow both synthesis by analysing the disappearance of the O-H (3500-3200 cm^{-1}) band and the appearance of the N-H (3390 and 1530 cm^{-1}) bands indicates the formation of the polyurethane (PU). Later, the disappearance of N=C=O band and the appearance of the C=C band where evaluated, which indicates the formation of polyurethane (meth)acrylate. Then, by adding monomers and photoinitiator, UV curable PUA resins are obtained and characterized using real time FTIR (RT-FTIR), differential scanning calorimetry (DSC) and thermogravimetric analyse (TGA), among others techniques. Finally, the influence of the acrylates on the mechanical properties of the films were also studied (Figure 1). It is important to notice that the obtained films present an excellent transparency and mechanical properties. In addition, the swelling rate observed for these materials amply their possible applications since they could be used as drug delivery systems.

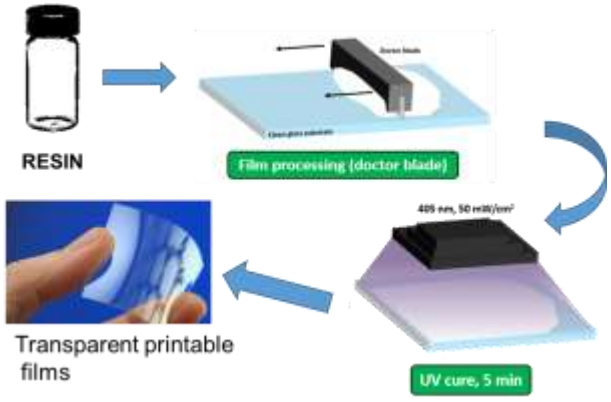

Figure 1: Scheme of the polyurethane (meth)acrylated films formation.

References

[1] A. Tiwari, A. Polykarpov, Photocured Materials, The Royal Society of Chemistry, 1 (2015)15.
[2] J. S. Choia, J. Seob, S. B. Khanc, E. S. Janga, H. Hana, Prog. Org. Coat., 71 (2011) 110.