Functionalization of Polyhydroxyurethanes by α-Alkylidene Cyclic Carbonates Towards New Elastomers for 3D-Printed Biomedical Devices

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The versatility of polyurethanes (PUs) makes them one of the most widely used and produced types of polymers in the world. They are historically synthesized from diols and diisocyanates. Unfortunately, isocyanates compounds are toxic chemicals, responsible for health and environmental problems. This issue has led to safer and more environmental-friendly routes, like the polyaddition of diamines and bis(cyclic carbonate)s[1], which avoid the use of these reagents and lead to non-isocyanate polyurethanes (NIPUs). Some PUs are also biocompatible and biostable, which makes them suitable for numerous biomedical applications. However, they revealed long-term implantation problems, which advanced polymer materials such as NIPUs could potentially overcome, by showing better durability and biocompatibility. Here, new NIPU-based elastomers are synthesized by functionalization of the hydroxyl groups of poly(propylene glycol)-polyhydroxyurethane (PPG-PHU) with an α-alkylidene cyclic carbonate (αCC), a CO_2-based compound exhibiting an enhanced reactivity towards alcohols compared to conventional cyclic carbonates[2] Selecting a αCC carrying a pendant unsaturation[3] allows the subsequent photocrosslinking of the functionalized PPG-PHU with various polythiols into elastomers. The influence of the type of crosslinking agent on the network properties was demonstrated by thermal and mechanical characterizations. Rheology experiments were also performed on the formulations in order to measure their gel points and gelation times. These results demonstrate that these new functional NIPUs are promising materials for 3D photoprinting and for the future design of medical devices. Finally, *in vitro* living/dead cells and hemolysis tests were performed on these materials, evidencing their non-cytotoxicity and their hemocompatibility.

References:

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