End-group modified toughness enhancers for bone replacement materials

B. Dellago[1,2,3*], R. Liska[2,3], S. Baudis[1,2,3]

[1]*Christian Doppler Laboratory for Advanced Polymers for Biomaterials and 3D Printing, Vienna, Austria*
[2]*Institute of Applied Synthetic Chemistry, TU Wien/E163-MC, Vienna, Austria*
[3]Austrian Cluster for Tissue Regeneration
[*]*barbara.dellago@tuwien.ac.at*

High reaction rates and good mechanical properties can be obtained upon photopolymerization of (meth)acrylates, making these monomers promising for producing patient-specific bone replacement materials *via* digital light processing stereolithography. Unfortunately, these compounds may show high irritancy and, in some cases, cytotoxicity. Furthermore, formed upon degradation, poly(acids) can harm the surrounding tissue. As circumvention, vinyl esters combined with thiols are very promising. The thiol-ene polymerization boosters the reactivity and material's impact resistance [1]. Another approach to further increase the toughness of the final scaffold is the incorporation of high molecular weight toughness enhancers into the polymer network. Based on polycaprolactone (PCL) to obtain biodegradability and biocompatibility, these additives exhibit promising results [2].

Herein, a study of the synthesis and characterization of several PCLs modified with different photopolymerizable end-groups is presented. RT-FTIR-photorheology measurements, tensile tests, and dynamic mechanical thermal analysis were conducted to determine their influence on the final polymer network. These toughness enhancer modifications improve reactivity, double bond conversion, and tensile toughness while keeping the glass transition temperature above the body temperature. Specific toughness enhancers can be designed for each application to tune the (thermo)mechanical properties. These results prove the applicability of modified PCL as toughness enhancers in polymer networks for bone replacement materials to treat bone injuries.

Keywords: biomaterials; polyesters; photopolymerization; FT-IR; toughness;

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