Medical Devices based on Additive Manufactured Biomaterials

Stefan Baudis[a,b]

[a]Christian Doppler Laboratory for Advanced Polymers for Biomaterials and 3D Printing
[b]Institute of Applied Synthetic Chemistry, TU Wien, Getreidemarkt 9/163MC,
1060 Vienna, Austria
stefan.baudis@tuwien.ac.at

Additive manufacturing technologies, including lithography (L-AMTs), open the possibility to provide patient-specific implants with feature resolutions down to the sub-micron range. [1,2] As biocompatible photopolymer precursors, the basis for L-AMTs, vinyl esters (VE, incl. vinyl carbonates) have been established, having orders of magnitudes lower toxicity compared to the state-of-the-art acrylate-based monomers [3] as well as favorable poly(vinyl alcohol) as degradation product. The low molecular weight poly(vinyl alcohol) can be excreted easily and residual monomers hydrolyze to acetic aldehyde. [4] In order to increase the reactivity of vinyl esters, they are combined with thiols (thiol-ene chemistry), attaining reactivities comparable with those of acrylates. [5]

A severe drawback of photopolymer based materials is their low impact resistance, owing their characteristic (highly crosslinked) polymer architecture. In order to increase the toughness, impact enhancers were developed, high molecular weight co-monomers as well as chain transfer agents, which are able to increase the toughness of these biocompatible materials and enable the fixation of the planned implants by screws. [6]

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