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Properties of bio-compatible polymers for 3d nanostructuring

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Two-Photon Polymerization (2PP) allows fabrication of arbitrary three-dimensional structures in the sub-micrometer range with controllable spatial and material properties. For 2PP a liquid resin consisting of cross-linkable monomers and a small amount of a photo initiator is used as matrix for writing. Femtosecond laser pulses and a high numerical aperture objective are used to create a focal volume with a high energy density. Therefor a simultaneous absorption of two photons by the photo initiator is probable. The excited photo initiator decays than into a chemical active radical, which starts the radical polymerization. Thus the cross-linking of the monomers yields the solidification of the polymer. Recent advances in three-dimensional nanolithography for tissue engineering requires for non-toxic materials mimicking tissue properties (eg. the extracellular matrix or cartilage). Typically for 3D lithography acrylate monomers are used because of their high reactivity. However, they are toxic. Up to now mostly methacrylates are used. However they are less reactive and therefore require a lower manufacturing velocity. In this work we present a new type of biocompatible polymer, which combines the reactivity of acrylates, the biocompatibility of methacrylates and the stability of thiols. The resins are structured using 2PP with a 515nm light source, a writing speeds up to several mm/s and sub-micrometer feature sizes. In order to characterize the mechanical properties of the manufactured scaffolds, atomic force microscopy (AFM) was used. The polymers Young's modulus have been characterized and compared to different available resins.

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