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SEGMENTED LINEAR THERMOPLASTIC URETHANE ELASTOMERS WITH NOVEL BUILDING BLOCKS FOR ELECTROSPINNING OF VASCULAR GRAFTS

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Tissue engineering is a promising approach in the treatment of diseases of the cardiovascular system. Cardiovascular diseases are the main cause of mortality in Austria and all the western countries. The commonly used materials, PTFE and Dacron, often fail when used for small diameter vascular grafts, mainly due to elastic and compliance mismatch and low hemocompatibility, causing thrombosis as a consequence. As alternative materials, thermoplastic polyurethane elastomers (TPUs) are under investigation. TPUs have a segmented configuration, consisting of a macrodiol as flexible soft block, and a combination of diisocyanate and chain extender as a rigid hard block. The result is an elastic material, matching the elasticity of a native blood vessel. Suitable mechanics and biocompatibility and biodegradation can be easily introduced by choosing appropriate building blocks, as well as degradation rates that correlate with the regrowth of native tissue. Biodegradability can be achieved by the use of cleavable building blocks, especially cleavable chain extenders. The materials' synthesis can be scaled up, and they are suitable for electrospinning as biocompatible fabrication technique.

In this work, we present the synthesis of various novel building blocks. Those building blocks were then used for the synthesis of novel TPU materials for small diameter vascular tissue engineering. The biocompatibility of the materials was known from literature and from research works within the group. Their water intake, mechanical and degradation behaviour were tested.

TWO-PHOTON POLYMERISATION OF HYALURONIC ACID-BASED HYDROGELS FOR TISSUE ENGINEERING

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Hydrogels, water-swollen networks of crosslinked hydrophilic polymers, have become the material of investigation for many biomedical applications in tissue engineering. Especially in the regenerative medicine user designed 3D scaffolds with a high resolution can revolutionize this field since different tissues require different 3D substructures for cell adhesion. Two-photon polymerisation meets these requirements of high resolution and accurate processing. However the commonly used materials for microscaffolds are based on PEG-diacrylates, which are very photoreactive but unfortunately cytotoxic¹. Beside the precise 3D-structure, other requirements such as water solubility, biocompatibility and biodegradation of the materials are desired. This talk presents a part of our work, where we concentrate on water soluble hyaluronic acid (HA), linear polysaccharide and an essential component of the extracellular matrix in human body. HA modification allows its crosslinking by two-photon polymerisation. Choosing less cytotoxic vinyl ester derivatives we obtained biocompatible, biodegradable and photopolymerisable materials. Swelling ratio, rheology measurements as well as cytotoxicity tests were used to characterize these new materials and compare the results to the (meth-) acrylates correspondents. On the top, our HA vinyl esters were used for a successful two-photon polymerisation and microfabrication of a 3D- scaffold/object could be demonstrated.

References:

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NOVEL LOW-TOXIC POLY(VINYL ALCOHOL) BASED HYDROGELS FOR TISSUE ENGINEERING VIA THIOL-ENE CROSSLINKING

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Tissue engineering is a part of biomedical engineering which has the aim to replace removed or unhealthy tissue until the body has rebuilt it completely. A high priority of tissue engineering is the production of synthetic tissue that resembles real tissue as much as possible. Biocompatibility is defined as "the ability of a material to perform with an appropriate host response in a specific application" and is of uttermost importance for any material that should be used in the field of tissue engineering.

Here we present novel modifications of the synthetic polymer poly(vinyl alcohol) (PVA) that were developed for usage in the field of biomedical engineering. PVA is a non-toxic (FDA approved), water-soluble polymer that has already been modified by a bunch of different functional groups.

In this work PVA was modified successfully with allylsuccinic groups (PVA-Allyl) and crosslinked with thiol-group bearing molecules via photopolymerisation. Photorheological measurements were conducted to analyse the optimal thiol to ene ratio, the influence of the initiator concentration and the influence of the macromer concentration in the formulation.

Furthermore cytotoxicology studies were carried out to prove that new PVA derivatives are usable for tissue engineering. Also storage stability of the formulations and swelling properties of selected hydrogels were analysed during these studies.

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PROGRAMME and BOOK of ABSTRACTS

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