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Mein Zeichen: GPP
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Project title: pHMed - Solution spun PLA fibres with pH-neutral degradation characteristics

Partner: ITA – Institut für Textiltechnik der RWTH Aachen
AME - Helmholtz Institute for Biomedical Engineering
DWI-Leibniz Institut for interactive Materialien
Fournè Maschinenbau GmbH
EnvisonTec GmbH

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Mission Statement

In medicine biodegradable materials have been successfully used as sutures, in drug delivery systems and in osteosynthesis systems. Important advantages of their use are prevention of a second operation for implant removal and prevention of long-term foreign body reactions. Polyhydroxycarboxylicacids, e.g. polylactides (PLA) and polyglycolides (PGA), are established biodegradable materials. The hydrolytic degradation of the polymer is accompanied by a release of degradation products, which can cause local acidosis. The drop of the pH-value may lead to massive inflammatory body reactions up to complete loss of surrounding tissue.
Thus the aims of the project are to develop of a novel biodegradable material with pH-neutral degradation characteristics and to enable the processing of the material as a textile medical product and complex patient-invidualised implant by rapid prototyping. By using a material system made of biodegradable material (PLA) and microgels a pH-neutral degradation shall be achieved. Amine-based microgels are colloidal polymer networks, which are suitable as a buffering component due to their high biocompatibility and proton binding capacity.

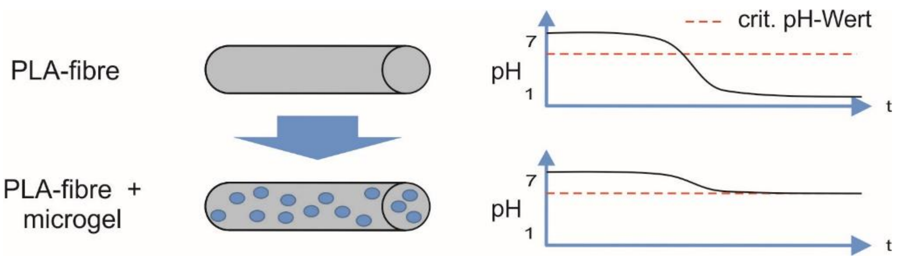

Fig.1: Schematic presentation of the degradation characterisitcs of PLA fibres

The superiority of PLA-fibres with incorporated microgels was shown in previous trials. However the uncontrolled distribution of microgels in the fibres leads to an unstable spinning process and high variation in tensile strength of the spun fibres.

Approach

The approach of the project regarding the fibre formation is the development of a bi-component spinning process that enables the spatially defined incorporation of microgels into PLA fibres. The combination of a buffering and a strength-giving component (e.g. sheath-core structure) is intended to generate fibres with pH-neutral degradation characteristics, which are suitable for further fibre processing. In spinning trials the spinning technology (dry / wet / airgap spinning), the spinning solution, process parameters and nozzle geometry will be systematically varied. Subsequently fibres will be evaluated by degradation studies, microscopy and tensile testing. The chair of Biohybrid and Medical textiles of the RWTH Aachen is conducting the development of the bicomponent solvent spinning process in cooperation with Fourné Maschinenbau GmbH.
Other aspects of research in the framework of this project are examination of microgel synthesis (DWI-Leibniz Institute for interactive materials / DWI) and the production of nanoscale fibres in a bicomponent electrospinning process (DWI). Additionally the spatially defined incorporation of microgels in non-fibre structures are investigated by EnvisionTec GmbH. This includes in particular the development of a process to produce PLA structures with incorporated microgels, which degrade pH-neutral.

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