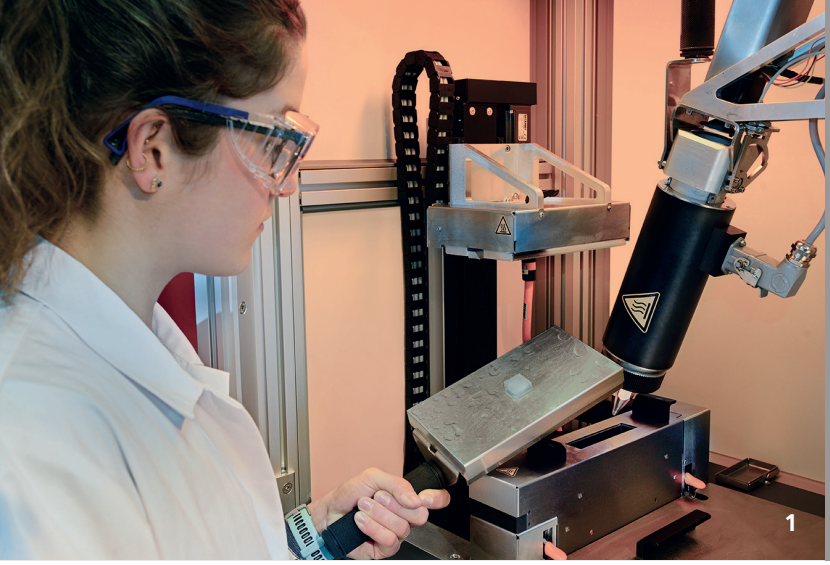

ARCHITISSUE – 3D ARCHITECTURE OF BIOHYBRID HEART VALVES MADE WITH ADDITIVE MANUFACTURING

Task

As life expectancy rises, society in general ages and diseases typical of old age increase. One of the most common of these diseases is heart failure, the cause of which includes diseases or malfunctions of the heart valve. Today's heart valve replacements, whether of biological or technical origin, have several disadvantages. Biohybrid soft tissue implants represent a promising alternative in this respect. By using a durable, reinforcing scaffold as technical component surrounded by the patient's own cells as a biological component, research can exploit the innovative potential of heart valve replacements specifically adapted and highly compatible to the patient. The production of the required 3D scaffold structures is being examined using laser-based stereolithography.

Method

To fabricate 3D scaffold structures, the Chair for Laser Technology LLT and Fraunhofer ILT are using current insights into photoinitiator-free photochemical polymerization to combine it with innovative stereolithography for processing hot-melt photopolymers. The biofabrication group is developing high viscosity thiol-ene photopolymers to improve their mechanical stability and elasticity as well as their biocompatibility, and processing them with high resolution stereolithography. To tailor the mechanical properties of the 3D scaffolds, the group is also systematically exploring different unit cell designs as well as their spatial arrangement.

Results

Laser stereolithography was used to manufacture 3D scaffold structures and to adapt their mechanical properties by both dimensioning the scaffold architecture and adjusting the photopolymer composition. The unit cells used range in size from a few micrometers to a few millimeters in edge length. Proliferation and cytotoxicity tests were used to demonstrate that the polymers are biocompatible.

Applications

Biocompatible scaffolds are mainly produced for novel implants in regenerative medicine and for organoid test systems in the pharmaceutical industry. Furthermore, 3D microstructured polymeric materials can be used to open up new possibilities for producing adaptive components in the plastics industry.

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1 Removal of a 3D scaffold green body from the SLA system.

2 Light microscopic image of a 3D scaffold structure.