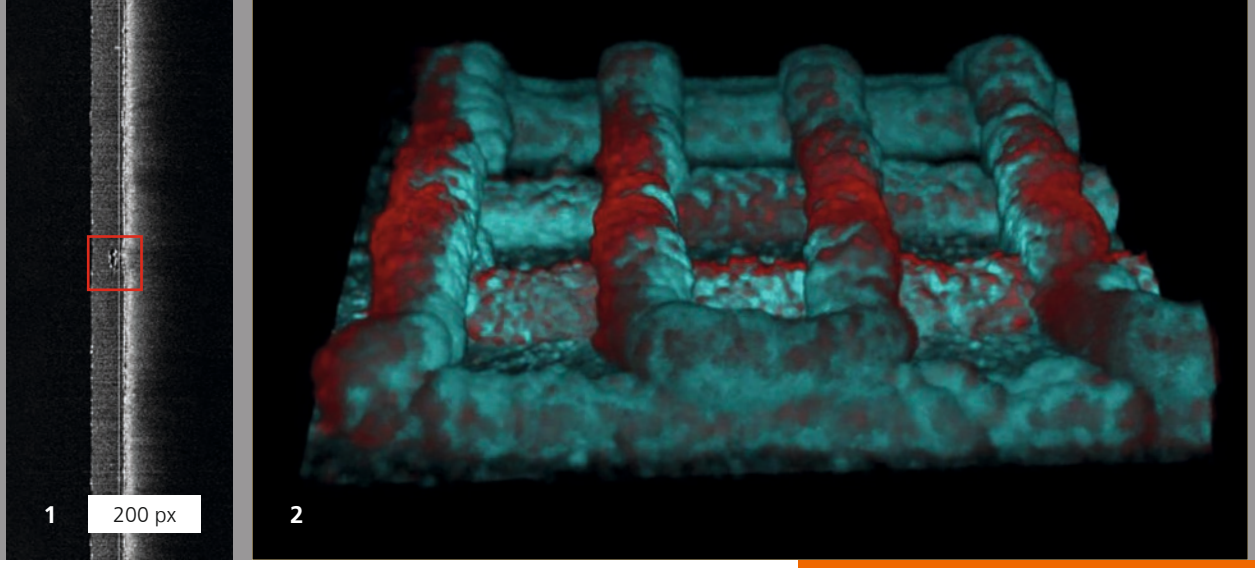

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EVALUATION OF BIOLOGICAL 3D PRINTING PROCESSES USING OCT

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Additive manufacturing (AM) is becoming increasingly important in all fields of industrial application. In medical technology, the artificial production of tissue, known as tissue engineering, is of particular relevance. The aim is to produce highly individualized structures, partly mixed with living cells, in small batches. To achieve this, suitable biomaterials must be developed, in addition to 3D printing technologies for biocompatible implants.

Monitoring the 3D printing of biomaterials

In biological 3D printing, called bioprinting, quality control is challenging due to the fragility of the tissues produced. Technologies for the monitoring of bioprinting processes must be fast, contact-free and radiation-free in order to be directly applicable in the manufacturing process. Optical coherence tomography (OCT) meets these criteria. The imaging measurement method based on white-light interferometry has been established in ophthalmology for many years but is also increasingly used for non-destructive material testing. OCT can be used to obtain topographic information for semi-transparent sample systems, as well as information about the internal structures of the object.

Integration of OCT in a 3D printer

In order to evaluate OCT for use in biological 3D printing, an OCT measurement module was successfully integrated into a bio 3D printer from RegenHU Ltd. Initial in-situ investigations were carried out during the strand deposition process. The effects of different process parameters (strand deposition height and atomization pressure) and materials (alginates and xerogels) on the deposited strand were examined. The cross-sectional area of the deposited ribbon allows conclusions to be drawn about the print quality.

In addition to quality control, the integration of an OCT module has further advantages: Since printed structures do not have to be removed from the 3D printer and prepared for further examination, changes and damages to or the destruction of the object can be ruled out. After printing, a full 3D image of the structure can be taken, enabling a digital comparison with the CAD model to verify manufacturing accuracy. Furthermore, the OCT module offers the possibility to dynamically record or monitor the drying behavior directly after the printing process. These studies on the printing process are part of the materials research of the biomaterials used.

The investigations presented here were carried out in cooperation with the Technical University of Dresden (Max Bergmann Center for Biomaterials Dresden).

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1 *Reconstruction of a strand printed on a base; undesired inclusions in the strand material are marked.*

2 *Comparative tomograms of a printed grid-like structure before and after drying; differing areas are shown in red.*

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