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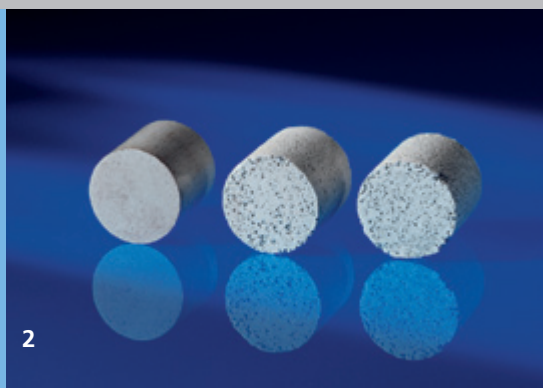
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1 *Injection molded interference screws made from PLA, hydroxy-apatite and stainless steel.*
2 *HA-PLA-scaffolds with varying porosity for bone repair.*

MATERIAL DEVELOPMENT AND SHAPE FORMING FOR MEDICAL IMPLANTS

Fraunhofer-Institute for Manufacturing and Advanced Materials IFAM
Shaping and Functional Materials

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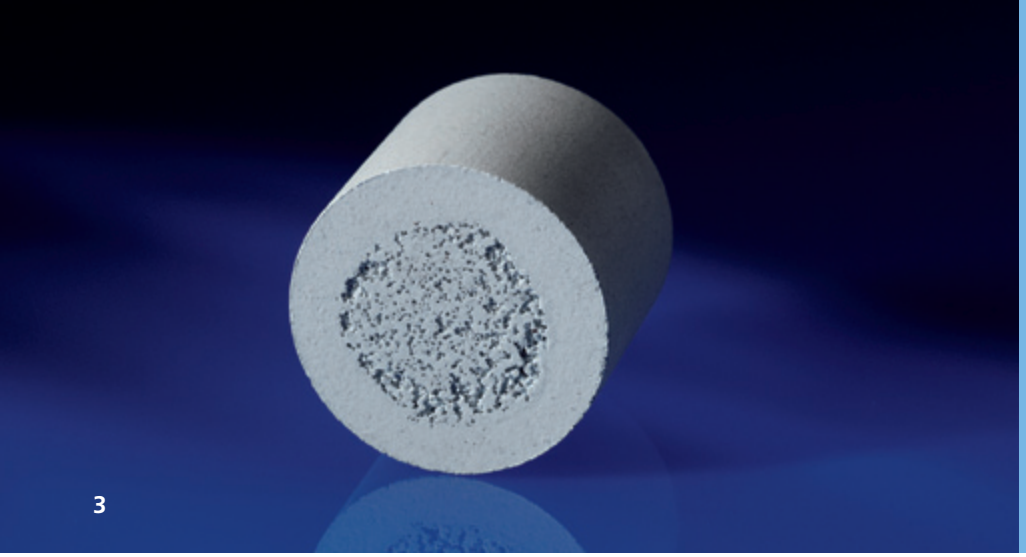
Medical implants are shifting more and more from passive, bioinert parts to bio-active, cell growth managing components. These functions are accomplished in various ways, for example by coating with active substances. As an alternative to such an approach, Fraunhofer IFAM is developing application-specific materials and shape forming technologies.

Surface structure and porosity massively influence cell proliferation and adhesion by their shape and size and thus the implant integration. Depending on the application, fully dense parts or components providing up to 70% open porosity made of metallic materials or bioceramics can be produced. Additionally, regular surface patterns in the micrometer range (down to 5 µm structure detail) can be realized for improved cell performance.

Medical Screws

The demands made on surgical screws are high. If they are to remain permanently in the body, they must combine high bio-compatibility, mechanical strength and corrosion resistance. Therefore they are usually made of titanium alloys. In the Metal Injection Molding (MIM) process used at Fraunhofer IFAM, the implant shape is predetermined in the shape forming process and subsequent machining can be omitted. The material properties are adjusted by applying appropriate sintering technology.

In some cases implants are required which are replaced by the body's own tissues over time. Such bioactive and resorbable implants generally consist of medical calcium phosphate and its composites. Powder Injection Molding has been developed at



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Fraunhofer IFAM based on these materials. For instance injection molded and sintered hydroxyapatite-ceramics achieve a flexural strength of up to 70 MPa.

Bone Repair - Bone Scaffolds

Often whole bone parts have to be replaced or repaired following accidents and injuries. Here it is important to offer the cells of the body a scaffold for rapid growth while maintaining the shape of the replaced tissue.

In particular porous bone replacement shape forming processes and materials based on hydroxyapatite (HA) and biopolymers (for example PLA) are developed at Fraunhofer IFAM. The composites mimic the structure and composition of natural bone. Depending on their porosity, the compressive strengths can be adjusted between 4 and 140 MPa. Density and hardness of the HA-PLA composites of 2.3 g/cm³ and 43 HV are very close to their natural counterparts (1.8 to 2.1 g/cm³ and 35 HV).

Our Offer

- Material and process development
- Production up to pilot series
- Mechanical and biological characterization
- Feasibility studies

3 *Bone replica, recreating the dense and porous structure of a bone.*