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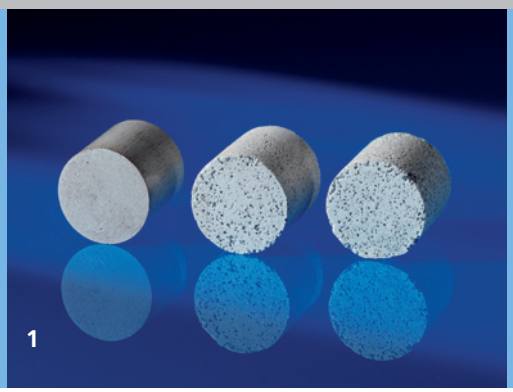
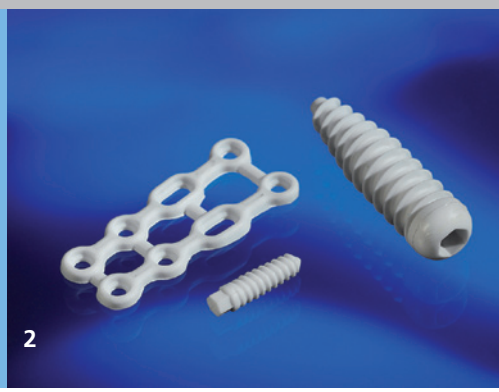
FRAUNHOFER INSTITUTE FOR MANUFACTURING TECHNOLOGY AND ADVANCED MATERIALS IFAM





1 *Composites with different grades of porosity produced by place holder technique.*
2 *Composite implants: trauma plate, dental implant and ACL reconstruction screw.*

POLYMER COMPOSITES FOR MEDICAL IMPLANTS

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

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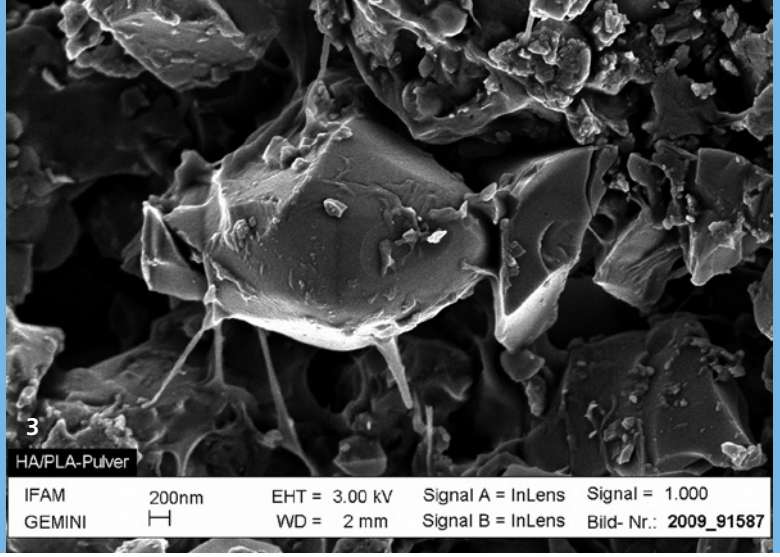
Medical implants are shifting more and more from passive, bioinert parts to bioactive, resorbable and cell growth managing components. These functions can be accomplished by developing polymer-bioceramic composites with special tailored filler content, porosity and surface functionality. Fraunhofer IFAM is developing such application-specific materials in combination with suitable processing technologies.

Composite preparation

For the preparation of homogeneous composites covering a broad range of polymer-ceramic ratios, the versatile process of liquid phase deposition was established at Fraunhofer IFAM.

As seen in the schematic drawing on the reverse side, the polymer is dissolved in a suitable solvent. Then the particulate filler material is added to the solution and the dispersion homogenized. Subsequently, the solvent is removed and the composite further milled to obtain a granulate or fine powder. Via this preparation route, filler contents in the polymer matrix can be increased considerably compared to state-of-the-art composites. Furthermore, the composites remain processable by direct shape forming techniques such as hot compaction and injection molding.



Scaffolds for tissue engineering

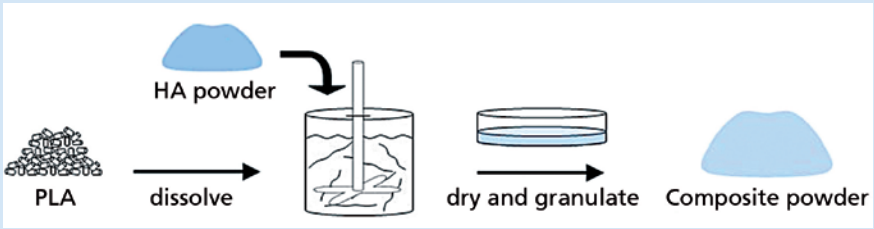
Hot compaction can be employed e.g. for the fabrication of scaffolds for bone tissue engineering. HA-PLA composites with HA shares up to 70 vol% show a high compression strength of up to 164 MPa. Bioactive and resorbable scaffolds can be obtained by using β-tricalcium phosphate (TCP) as particulate phase.
Porosity is introduced by suitable space holders that can be removed after compaction by dissolution processes.

ACL surgical screws

If the filler content is below 70 vol%, composites prepared by LPD can be processed directly by injection molding. This offers additional freedom in the complexity of the parts and paves the way for implant production. At Fraunhofer IFAM, the injection molding process was optimized to process surgical screws suitable for ACL reconstruction. The material is composed of 40 vol% TCP and 60 vol% PLA, combining high ductility, strength and controllable bioresorbability. Obviously, depending on the composition, further applications in trauma or dental implants are feasible.

Our offer

- Material and process development for polymer based composites
- Production up to pilot series
- Mechanical characterization
- Cell culture and biocompatibility in vitro
- Feasibility studies and market analyses



Schematic illustration of the LPD composite preparation process

3 *SEM image of a hydroxyapatite-polylactic acid (HA-PLA) composite powder.*