Preparation of polylactide-ceramic microparticles for individual biodegradable implants by selective laser melting (SLM)

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Aim
A flowable, biodegradable and printable polymer-ceramic-microcomposite system which is suitable for the additive manufacturing of bone substitution materials by selective laser melting was prepared. This potential bone substitution material is based on poly(*L*-lactide-co-*D,L*-lactide) as the organic phase with either calcium phosphate nanoparticles or calcium carbonate nanoparticles as the inorganic phase. This material does not influence the pH during degradation and is easily processable by powder technology.

Methods
Microcomposite systems with different compositions were prepared by a solid-in-oil-in-water emulsion solvent evaporation method and analyzed by electron microscopy, thermogravimetry, differential scanning calorimetry, flowability, cell proliferation experiments, and mechanical testing.

Results
The preparation leads to particles with an average diameter of 10-70 µm and a homogeneous distribution of the ceramic component inside the particle. The addition of the ceramic nanoparticles compensated for the acidic degradation of polylactide, to an enhanced proliferation of MC3T3-cells (osteoblasts) on the surface, and also to improved mechanical properties of hot-pressed test specimen in three-point bending.

Conclusion
It was possible to prepare a polymer-ceramic-microcomposite powder based on poly(*L*-lactide-co-*D,L*-lactide) as the organic phase with either calcium phosphate nanoparticles or calcium carbonate nanoparticles as the inorganic phase, which has all necessary properties for the additive manufacturing of individually shaped bone substitution materials.