JÜLICH FORSCHUNGSZENTRUM

Net-shaped manufacturing of highly porous parts by powder metallurgy

Innovation

At Forschungszentrum Jülich, powder metallurgical processing routes are developed for net-shape manufacturing of highly porous parts. The concept was successfully proven on several prototypes of biomedical implants (spine implant, acetabular cup, dental implant). In all cases, titanium powders were used for implant manufacturing. Generally, the technology can be easily transferred to other metal powders (e.g. steel, copper, molybdenum, NiTi) if they show suitable compaction behaviour.

Technology

Manufacturing of highly porous parts is based on powder metallurgy in combination with temporary space holder materials. In the case of the technology established at Forschungszentrum Jülich, net-shape manufacturing is done by mechanical machining of metal powder/space holder compacts in the unsintered state (“green machining”), followed by removal of space holder by decomposition in air at moderate temperatures. Finally, mechanical stability of highly porous parts is achieved by sintering. At the moment, another related technology is developed, which has a higher potential for fully automated manufacturing. Here, the concept of temporary space holders is transferred to well-known metal injection moulding process, which allows useing automated shaping technology established in plastics industry.

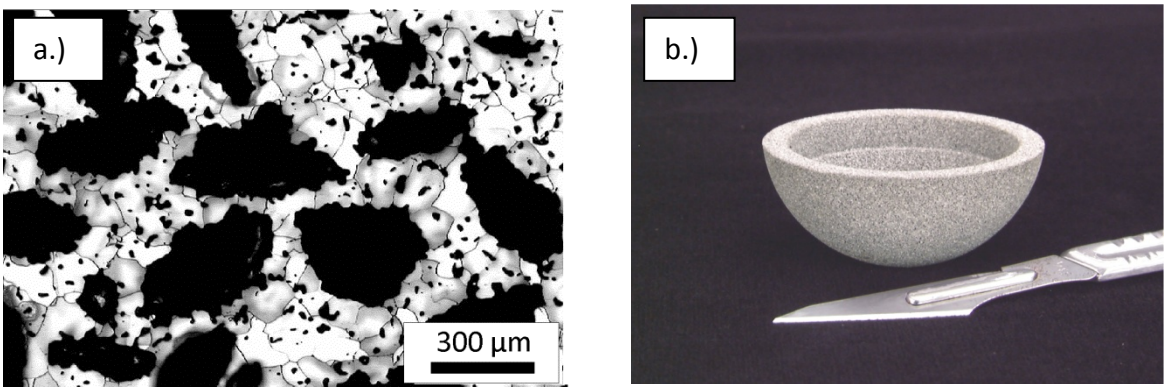

Figure 1: a.) Highly porous titanium manufactured by powder metallurgy with temporary space holder b.) Prototype of acetabular cup for full hip arthoplasty.

Benefits

Both technologies offer high potential for net-shape manufacturing of highly porous metal parts with well-defined porosities up to 80 vol. %. Furthermore, even pore size can be exactly adjusted by using related fractions of space holder particles. It should be considered that both technologies are preferentially suitable for small to medium sized part dimensions (< 100 mm).

Applications

- Biomedical implants for bone replacement, improved implant fixation by bone ingrowth, reduced risk of stress-shielding by adaption of Young´s modulus
- Small to medium sized parts for damping applications (e.g. from NiTi powders with pseudoelastic properties)
- Ballistic applications
- Light weight components
- Metallic structures for gas and liquid flow with high permeabilities

Next Steps

Forschungszentrum Jülich holds several patents (e.g. WO/2003/101647, WO/2004/039748) on these technologies and is interested in commercialization through licensing and/or R&D-cooperations.

Contact

Forschungszentrum Jülich GmbH
Geschäftsbereich Technologie-Transfer
Dr. Andrea Mahr
Wilhelm-Johnen-Straße
52428 Jülich
Tel.: +49 2461 61-9282
Mobil: +49 171 3031922
E-Mail: a.mahr@fz-juelich.de