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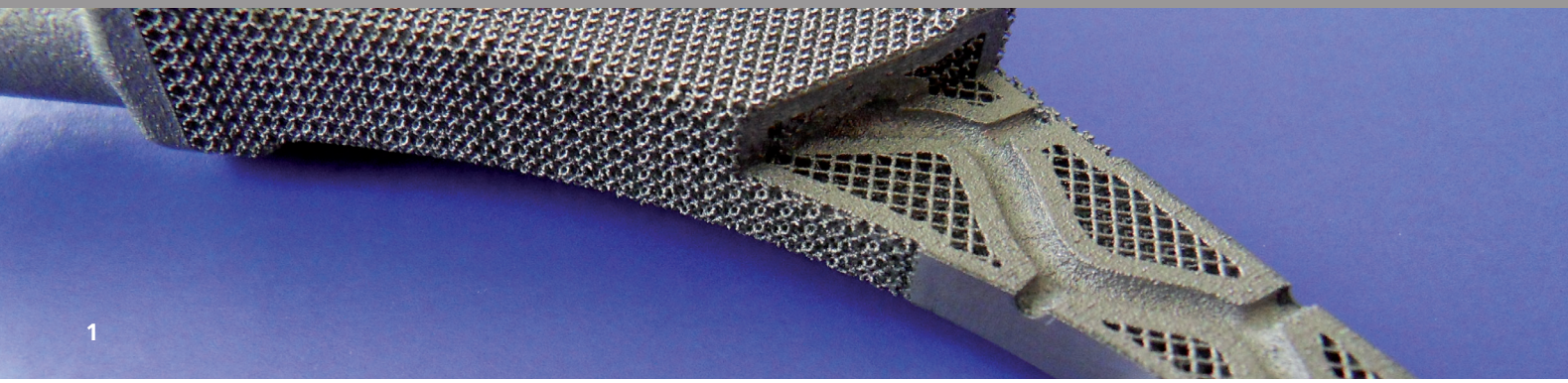
FRAUNHOFER INSTITUTE FOR MACHINE TOOLS AND FORMING TECHNOLOGY IWU



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1 *Beam melted hip stem prosthesis with functional channels and cavities, inner cellular structure and macro-porous surface areas*

IMPLANTS WITH INNER FUNCTIONAL CAVITIES

Motivation

Implants (endoprostheses) can partially or completely replace injured parts of the body such as worn joints or defective bone material and remain permanently inside the human body. Today, endoprostheses are predominantly manufactured by cutting, forming or casting technologies. However, there are restrictions in processing, e.g. the accessibility for cutting tools or draft angles for moulds and dies which finally restrict unlimited geometrical flexibility in the design of implants.

An innovative approach for the manufacturing of endoprostheses can be found in the additive manufacturing technology of beam melting. Thereby the implant gets manufactured by layer wise, local melting of metal with a laser or electron beam, based on 3D CAD data.

Via beam melting technologies, different bio-compatible and medical accredited metals can be processed, including commercially pure titanium and titanium alloys (e.g. Ti-6Al-4V or Ti-6Al-7Nb) or cobalt chromium alloys (e.g. CoCrMo). Furthermore, existing limitations of conventional manufacturing processes can be overcome thanks to the beam melting technology.

In addition to that, virtually any inner and outer design can be realized due to the tool-free additive process approach. Thus, completely new geometries and functions can be implemented in implants and being manufactured with beam melting technologies. Therefore, the beam melting technology is basically suited for direct manufacturing of individual implants based on computer or magnetic resonance tomography data as well as serial production (rapid manufacturing) of standardized implants.

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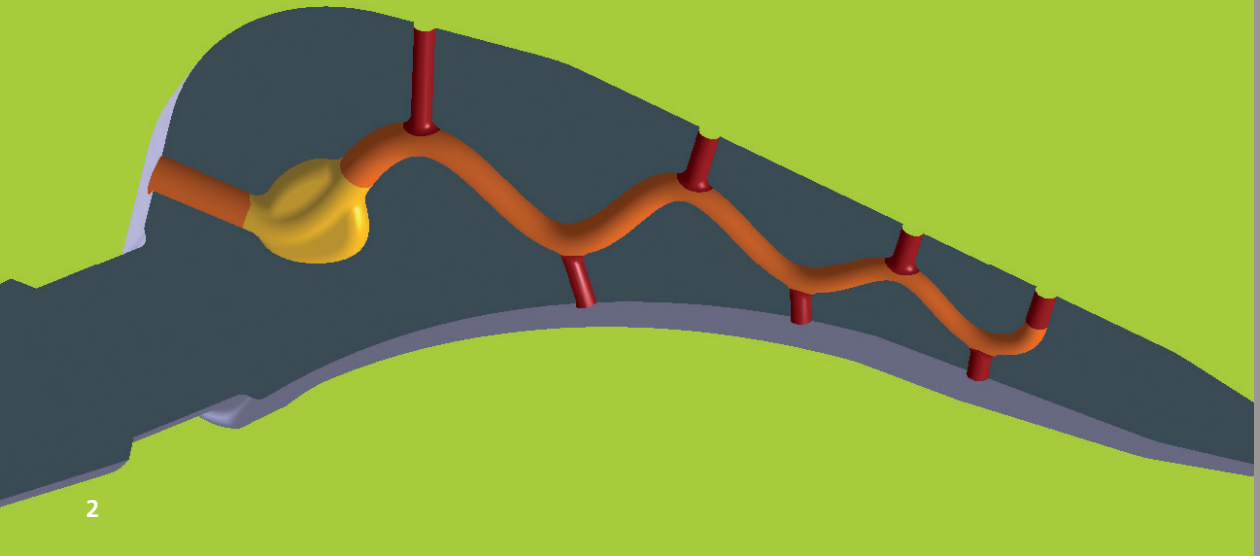

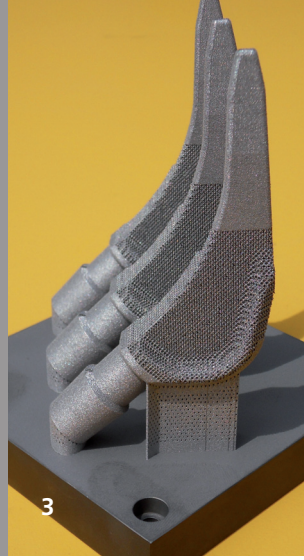

Innovation

The Fraunhofer IWU developed an implant with integrated complex functional channels and cavities which can be designed arbitrary in accordance to any specification profile. These channels and cavities provide additional functions in implants. This permits, for example, a better fixation of cement-free endoprostheses through the targeted local insertion of bone cement or bioresorbable filler after the implantation (compensation of inaccurate fit). Even years after implantation, you can counteract the loosening effect or take care of it.

Another added value of the presented endoprosthesis with functional cavities is the possibility of post-operative medical treatment for the patients. Thereby, the steady and regular release of medication from a cavity in the inside of the implant (drug depot) through defined channels to the surrounding bone and soft tissue (wound) becomes possible. This feature allows both, the aimed promotion of wound healing and the ingrowth behavior of somatic cells into the endoprosthesis.

In addition, medication for pain relief and prevention of infections can be supplied through the inner channels to the implant-tissue interface. If necessary, the channels can also be used for post-operative discharge of blood and wound ooze (drainage). Moreover, the inner channels allow an endoscopy in the contact area between implant and bone as well as the surrounding body tissue.

Consequently, another immediate option for post-operative medical monitoring alongside imaging technologies like computer tomography is to be created which allows earlier detection of possible complications. Finally, the functional channels can be utilized in case of a necessary explantation to distribute a medium for locally limited decomposition of implant-bone bonding in order to ease and speed up a surgical intervention for implant removal.

2 *CAD image of a hip stem prosthesis with drug depot (marked in yellow) and distribution channels (marked in orange and red)*

3 *Rapid manufacturing of hip stem prosthesis by means of beam melting technology*