



3



4

IMPLANT MANUFACTURE OUT OF COCR BY MEANS OF SLM AND LASER POLISHING

Task

In recent years, there has been a steady increase in operations to implant knee prostheses. Compared to standard knee prostheses, patient-specific knee prostheses have advantages with respect to their life and functionality. Thanks to modern imaging techniques such as CT, MRI or US combined with a personalized biomechanical simulation, an individual knee joint can be reconstructed. Today, most knee implants are made of CoCr by casting and additional machining. The functional surface (sliding surface on the femur) is mainly hand polished. A new approach to better solve this task is the combination of the additive manufacturing process SLM with the post-processing by laser polishing. To produce tailored knee implants, the specific task, then, is to create an SLM process control with subsequent post-processing by means of laser polishing for CoCr according to the ASTM F75 standard.

Method

In the first step, process parameters have been developed to process CoCr using SLM and reach a density of > 99.8 percent, and to significantly improve the surface quality of the SLM prostheses by the adjustment of process parameters in contour area. In the second step, the process parameters for laser polishing have been developed and transmitted to the relevant 3D geometry of the sliding surface of a knee prosthesis.

Result

Fraunhofer ILT has identified the process parameters for SLM that result in a density of $\rho \geq 99.8$ percent and a mean surface roughness of $R_a < 7 \mu\text{m}$. These parameters were used to produce a knee prosthesis with a standard size by SLM. Furthermore, process parameters were determined for laser polishing SLM samples made of CoCr. After this polishing step, the average surface roughness is $R_a < 0.3 \mu\text{m}$. This example has, therefore, demonstrated that these methods are feasible for the production and post-processing of implants made of CoCr.

Applications

The project was conducted within the scope of the NRW-funded project »RapidGEN«. The current research on the SLM processing of CoCr addresses prosthesis manufacturing in medical fields and can be transferred to other applications that use CoCr as the working material.

Contacts

Dipl.-Ing. Liyaowei Shen
Telephone +49 241 8906-8092
liyaowei.shen@ilt.fraunhofer.de

Dipl.-Ing. Ingo Ross
Telephone +49 241 8906-8196
ingo.ross@ilt.fraunhofer.de

- 3 Laser-polished SLM sample out of CoCr.
4 SLM-manufactured knee prosthesis,
sliding surface partially laser polished.