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Production of near-net-shape implants with graded porosity by 2-C-MIM

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Abstract - The near-net-shape production of titanium implants with a graded porosity is demonstrated by a novel technique, the 2-component-metal injection moulding (2-C-MIM) [1,2]. The combination of porous and dense parts is of advantage for the implant application, as the porous outer layer aids the osseointegration while the dense part supports the mechanical stability [3]. The pores are achieved by the space holder method (SHM) [4], using NaCl as a space holder. The use of space holder particles requires a careful optimization of the feedstock used, as well as the MIM process itself. The first prototypes were characterized in terms of microstructure and mechanical properties.

2-component injection moulding is already established in the plastics industry, where plastic materials of different colours or with different characteristics are combined. The moulded parts are produced in which the individual components are clearly separated from each other. The combination of materials in one moulded part characterises its appearance and functionality. The implementation of this technique for the metal injection molding (MIM) is being investigated for the production of near-net-shape titanium medical implants with a gradient in porosity.

The pores are formed by the space holder method (SHM). By this technique, the metal powder together with the space holder and the binder are homogeneised in a kneader. The green parts are injection moulded and the space holder removed after the first stage of debinding. The parts are then thermally debinded and sintered. The SHM guarantees a well defined pore size distribution with total porosities up to 70%.

By the 2-C-MIM, feedstocks with and without space holder are injected and parts composed of materials with different characteristics are produced. A careful optimisation of the binder system was required, as well as an optimisation of the MIM process.After debinding, desalination and sintering, components with porous and dense parts are formed. One of the components produced is shown in the figure below.

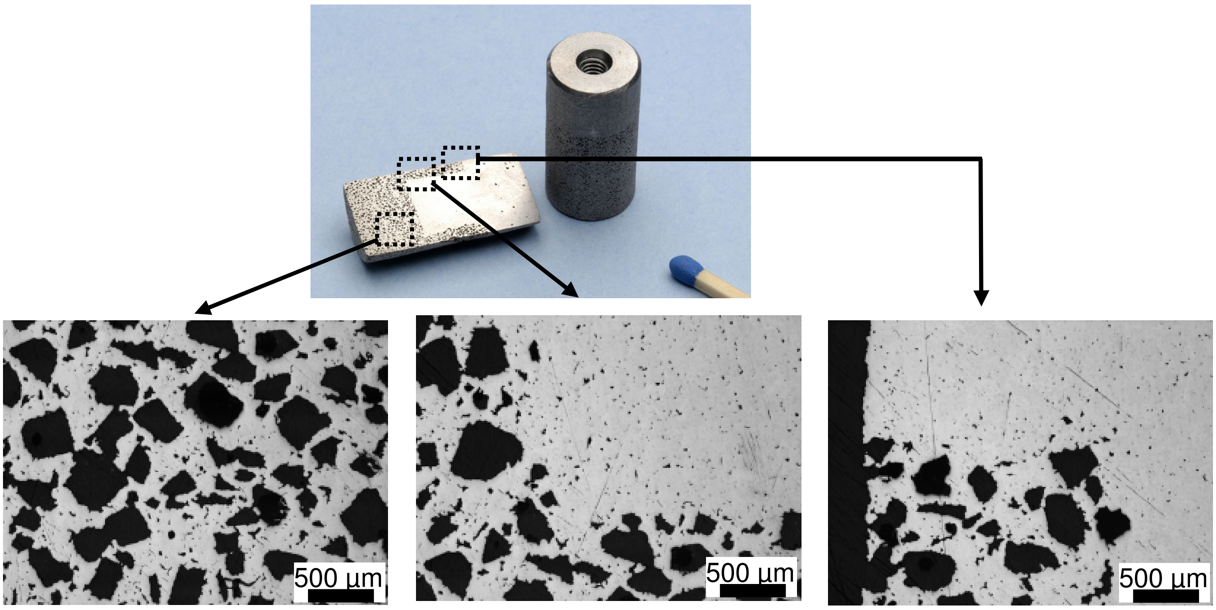

Figure 1: Microstructure of a sintered titanium implant prototype with a gradient in porosity. Sample produced by 2-C-insertion-MIM.

References

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