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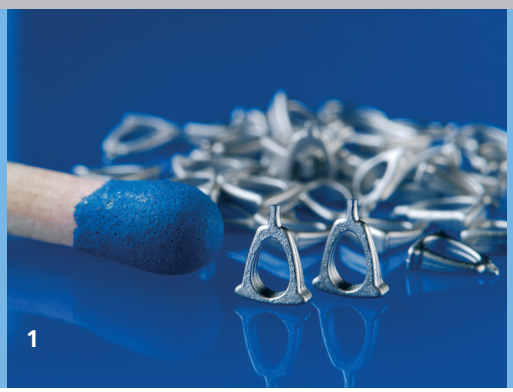

1 *Replica of the smallest human bone, the stirrup, by µ-MIM of stainless steel and titanium.*
2 *Magnetic-nonmagnetic flowmeter made by 2C-µ-MIM.*

POWDER BASED MICRO MANUFACTURING

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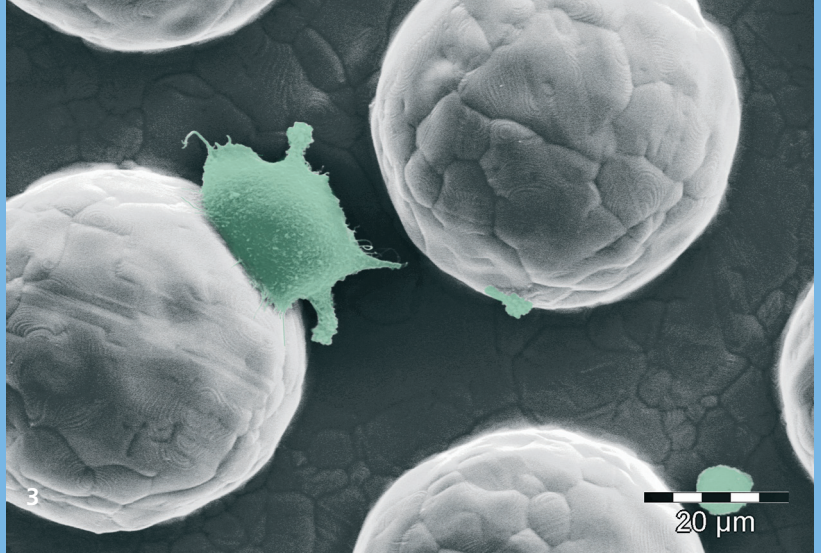
Due to the combination of high geometric complexity and large scale manufacturing of components, the process of Metal Injection Molding (MIM) extends the possibilities of well established technologies such as pressing, investment casting and machining. By combining the freedom in design of injection molding with the freedom in material selection given in powder metallurgy, it becomes possible to produce even complicated parts with undercuts, ribs, thin walls and surface structures in the micrometer range.

Micro Metal Injection Molding (µ-MIM)

With the increasing demand for miniaturized products, precise micro components from metallic materials with optimized mechanical stability, corrosion resistance, thermal conductivity, or biocompatibility become more and more important.

Therefore, based on the extensive experience in MIM, Fraunhofer IFAM has developed the micro metal injection molding process (µ-MIM). Complex three-dimensional micro-parts and microstructured surfaces can be manufactured without post-processing. An illustrative example from the medical sector is the replica of stirrups (the smallest human bone, located in the ear), that Fraunhofer IFAM has realized in titanium and stainless steel. With a diameter of 1.4 mm, an aspect ratio of 23 was obtained. The minimum wall thickness of the parts is 280 µm ± 11 µm.



Two-component Micro Metal Injection Molding (2C-µ-MIM)

Two-component metal injection molding of micro parts (2C-µ-MIM) represents a further advancement in the µ-MIM technology. In this process, similar to multi-component plastic injection molding, two metallic materials are injected into one mold, so that a locally defined bond between the two materials is obtained. With 2C-µ-MIM a shape forming technology is available that allows a number of possible combinations of properties and integration of multiple functions into one component. For instance, the process technology was developed at Fraunhofer IFAM to combine two stainless steels offering different magnetic properties. Figure 2 shows a corrosion resistant flow-meter with the main body made of a non-magnetic stainless steel and one magnetic wing for speed detection.

At Fraunhofer IFAM, extensive developments to expand the range of materials available for µ-MIM are being carried out. Apart from the classic stainless steels, we are focussing on the development of advanced high-purity metals, shape memory alloys, cobalt-chrome based materials for implants or tungsten-copper composites for application as heat sinks for optoelectronics.

Our Offer

- Development of cost efficient, volume manufacturing processes for micro parts and micro structured surfaces with complex geometry
- Complete process chain for the Micro Metal Injection Molding (µ-MIM) process, including 3D simulation
- Process development with state-of-the-art industrial equipment up to pilot series production
- Transfer of research and development results including training of staff

3 *Cell adhesion on a micro-structured surface manufactured by µ-MIM for cell growth management on implants.*