Metal Injection Molding Technical Newsletter

World's Finest MIM Technology from Japan "μ -MIM ®"

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1. With MIM mass production of ultra-small gears become possible

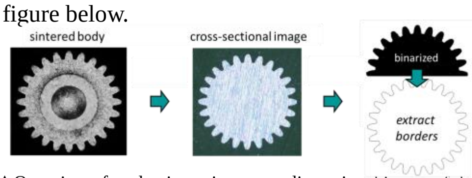
(1) Diameter 1mm or less! Taisei Kogyo's μ-MIM makes the impossible possible!

Along with weight reduction and miniaturization of the various types of precision equipment, the same is required of the gears which function as the internal drive components. However, production by machining becomes difficult in the case of micro gears with a diameter of several mm or less, and moreover the shapes are special, with bevel, miter or helical teeth, etc. Taisei Kogyo is continuing to develop specially shaped micro-gears using MIM.

▲Examples of ultra-small gears
Pinion gear (left): Diameter: 0.85mm; Number of teeth: 10 Rack (right): Length: 6mm; Wall thickness: 0.5mm; Tooth pitch: 0.22mm

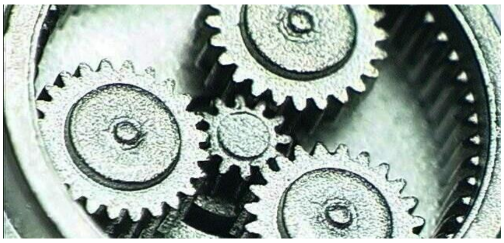
(2) It has also become possible to guarantee the accuracy of micro gears.

For example, it is very difficult to mass-produce by machining gears of the shape and size shown in the image above. At present, mass production of micro-gears with accuracy equivalent to that obtainable by machining is possible only using our μ-MIM technology.
The gear production described above also poses a number of challenges at the stage of evaluation. Regarding not just gears produced by μ-MIM, but also, as discussed in earlier issues of this newsletter, in relation to high-precision, delicately shaped parts, while quality assurance is very important, the measurement and evaluation of quality assurance is extremely difficult.
In the case of generic sized gears, evaluation can be carried out by examining the meshing using a master gear, or by contact-type shape measurement, but in the case of fine/microscopic gears with a diameter of only several millimeters, it is difficult to produce a master gear, and also, for contact-type shape measurement, there is a limit to the probe size, so there can be no absolute evaluation because it is difficult to ensure accurate measurement.
There is no JIS standard for micro-gears, so an evaluation method that goes beyond the traditional measurement and evaluation methods will be necessary. At Taisei Kogyo, we have been extracting and evaluating the outer frame shape of gears from the two-dimensional image data obtained with a microscope, such as shown in the figure below.



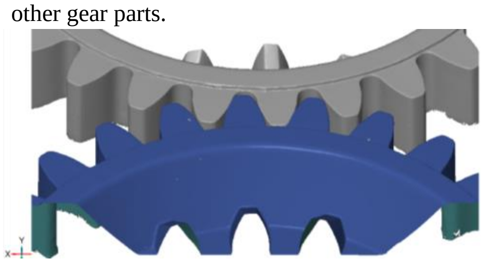
▲Overview of evaluation using a two-dimensional image of the gear (from left, sintered body, cross-sectional polished optical microscope image, binarization of image, extraction and assessment of border).

In addition to this evaluation method, we have been using a three-dimensional non-contact image measuring instrument (ATOS) (please refer to Vol.4) to evaluate micro-gears. Using this image measurement evaluation method, we are achieving quicker and more accurate evaluations. Currently, we are working to improve evaluation methods.



▲Center, middle and outer gears have to move smoothly

Gears are said to be powered by mutual engagement of their teeth, but in the design of this meshing, there are other elements in addition to shape that need to be noted. For example, in the case of parts with multiple gears engaging with each other, such as in the above photo, if the surface condition of the teeth is not appropriate, the gears will not rotate well. At Taisei Kogyo we uptake the shape of the micro-gears to the computer as three-dimensional data, combine this with the CAD data at the time of design, and carry out a simulation of combination with the other gear parts.



▲Meshing simulation image

2. Mass production with MIM of parts from difficult-to-machine materials

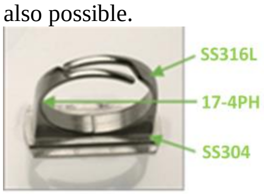
Because MIM obtains a net shape by sintering a metal powder, MIM strengths are clearly exhibited when the parts have poor processability and material yield.

We can handle difficult-to-cut materials such as titanium. We have focused on the development of MIM manufacturing methods for cemented carbide, titanium is in mass production, and cemented carbide is also available at some stages of practical use.

We will continue aggressive development, so we await your inquiries concerning parts from difficult-to-cut materials.

3. Introduction to sintering bonding technology

At the junction of MIM parts, bolts, rivets and adhesive are not required.
MIM produces the shape of the part by injection molding, and thereafter we obtain the elaborate metal part by sintering. We pay attention to this sintering process, and we also have the technology to bond the separately molded parts at the time of sintering. Accordingly, complex shaped parts that cannot be formed by a mold alone can be manufactured as unified parts. This approach does not require fastening components such as adhesives, bolts or rivets. Furthermore, while it goes without saying that identical materials can be bonded, the bonding of different materials is also possible.



▲ Example of bonding of different, stainless materials
This image is an example of sintering of stainless steel powders of magnetic and non-magnetic materials. From the top, SS316L, 17-4PH, and SS304 have been bonded.

4. Exhibited at COMPAMED 2016

As usual we had a booth at COMPAMED, a part of the largest medical exhibition in Europe.

Thank you for coming to our booth.

Taisei Column

Hello everyone. My name is Iwatsu, and I am a technical advisor. I have been dealing with powder metallurgy for 45 years already, and during that time I have been involved in research and development relating to oil-impregnated bearings, metal powder manufacturing, · MIM etc..
I have built up deep personal connections with members of both academia (the Powder Metallurgy Society) and the industry. I would like to share with as many people as possible both inside and outside our company the knowledge that we have accumulated to date through our technical development here at Taisei Kogyo.

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