

Flexible Forming (FF) Process Enabling Forming of Compact Parts with Complex Shapes

Technical background

As a distinctive feature of the powder metallurgy (P/M) process, near-net shape production of parts with complex shapes is possible. However, because there are limits to the shapes which can be compacted with the conventional P/M process, MIM products and machined products are used, particularly for compact, multistage parts with complex shapes.

Hitachi Powdered Metals developed a special raw material in order to respond to the need for multistage, complex shapes in recent years, making it possible to form compact, multistage parts with complex shapes using the conventional P/M press. As a result, these parts can now be supplied at low cost.

Conventional technology

With compact multistage parts with complex shapes, segmentation of the punch is frequently difficult due to limitations on die strength and similar factors. Therefore, MIM products and machined products are used for multistage parts with complex shapes which are difficult to form by the conventional P/M process.

New technology

A special raw material was developed in order to form small parts with complex shapes with the conventional P/M press.

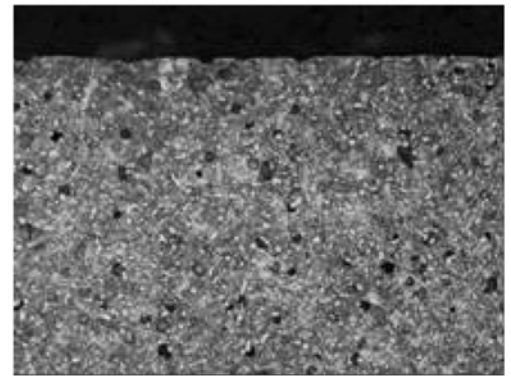
Adoption of this special raw material enables smooth transfer of the raw material filled in the die during press compaction, making it possible to form small multistage parts with complex shapes having uniform density using a simplified die structure.

Features of the new product

It is possible to form small multistage parts with complex shapes having large height differences without using a complicated mechanism such as segmentation of the compacting punch, etc.

(Examples of application)

With the newly-developed special raw material powder, high density (density ratio of 95% or higher) was obtained by optimizing the sintering temperature. Because it is also possible to obtain a microstructure in which fine Cr carbides are dispersed in a martensitic matrix by performing heat treatment, excellent wear resistance and contact pressure resistance can be obtained.



50 μm

Table Material properties (Actual values)

Density (density ratio)	7.55Mg/m ³ (96%)
Matrix hardness (Hv0.1)	709 (685-738)
Dimensional tolerance	±0.55%

Possible applications of the new product

· Small products with large height differences which are difficult to form by sheet metal processing or conventional P/M process.

Forming of product shapes (height difference: 180%) like that shown in the following photographs is possible.

*Includes cases in which some machining is necessary due to shapes such as side holes, undercut, etc.



Shape with 180% height difference



Cross-sectional view

10mm

*Height difference is the numerical value obtained for a shape with a height difference using the equation shown below.



$$\text{Height difference (\%)} = b/a \times 100$$