Behavior of a permanent magnet used for the high efficiency motor under the high frequency magnetic field

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The development of high efficiency motors is accelerating as energy problems become more serious. Many magnetic materials are used in high efficiency motors, and the demands on the properties of the magnetic materials are changing greatly by the use of power electronics[1].

For example, in soft magnetic materials such as electrical steel, increases in iron losses of 20% to 60% caused by the inverter excitation have been reported[1].

On the other hand, with hard magnets such as permanent magnets, the eddy current loss on the surface of the magnet cannot be neglected as the electric resistivity of rare earth sintered magnets is very low in comparison with ferrite sintered magnets.

As a result, the measurement and numerical analysis of losses under AC magnetic fields based on NdFeB sintered magnets has been studied[2)、3)].

With recent high speed motors, larger magnetic fields are applied to the magnet and the frequencies of those fields are higher, and as a result the problem of magnet losses will become more important.

We have manufactured a device to study the magnetic properties in a high AC magnetic field. With the device, we studied the magnetic properties of Nd sintered magnets, anisotropic bonded magnets and ferrite magnets.

The results show that while there is a large delay in the magnetization of Nd sintered magnets, this delay was small in Nd bonded magnets and the ferrite magnets.
This may be attributed to electrical resistivity.

However, it was difficult to perform the comparison of magnetic properties in high AC field with the normal BH tracer, because it was not possible to express the AC hysteresis with a magnetic unit.
This time, we have succeeded in expressing hysteresis with a magnetic unit.

Furthermore, we are remodeling the device to allow high frequency measurements while applying a static magnetic field to the magnet.

In this report, we report the outline of the device and results of a measurement.

Reference

1) K.Fujisaki : IEE Japan, MAG-13-149
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Fig.1 Experimental Apparatus

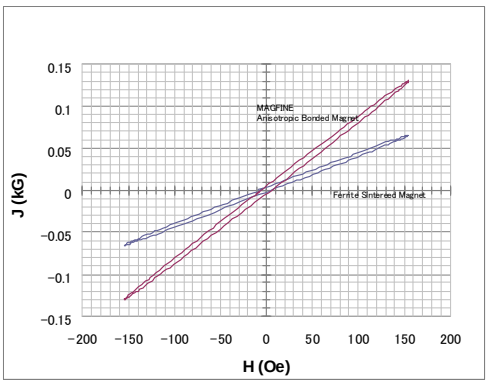

Fig.2 Minor loops in a high frequency magnetic field