

Development of Measurement Technique of Three-dimensional Demagnetization Distribution in Permanent Magnets for Motors

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It is important to estimate the demagnetization state in the magnets in Interior Permanent Magnet Synchronous Motors (IPMSMs), which are often used for consumer electronics and HEV traction motors. However, the distribution of demagnetization in permanent magnets for these motors is not uniform due to the difference of coercivity of local parts in the magnet material and the difference of the working point of local parts in the magnet caused by the variation of magnetic circuit in a motor. So, it was necessary to estimate the demagnetization distribution in the magnet by FEA, because there were not techniques to measure that. Therefore, we develop a method to evaluate the three-dimensional demagnetization state including the inside the magnet by cutting the magnet into the cubes, as shown in Fig. 1, and measuring the B-H characteristics of each magnet cube using Vibrating Sample Magnetometers (VSM), as shown in Fig. 2. At first we lock the motor rotation in high temperature environment, and an electric current is applied into a coil to hang opposing magnetic field. Next, magnets are taken out from the motor. Then, we cut the magnet into the cubes without demagnetizing anymore. Finally, we measure the B-H characteristics of each magnet cube shown as in Fig. 3 and calculate demagnetizing ratio distribution.

$$\text{Demagnetizing ratio[\%]} = (B1 - B2) / B1 \times 100 \quad [1]$$

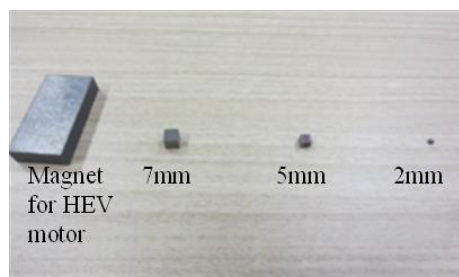


Fig.1. Magnet cut into cubes



Fig. 2. Vibrating Sample Magnetometers VSM

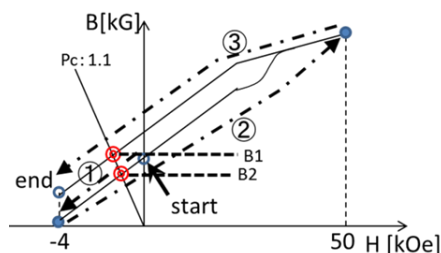


Fig.3. Calculation method of demagnetizing ratio

Reference

- 1) S. Araki, Y. Asano, A. Yamagiwa, "Development of Measurement Technique of Three-dimensional Demagnetization Distribution in Permanent Magnets for Motors (Part 1)" The paper of joint Technical Meeting on Rotating Machinery, Linear Drive and Home and Consumer Appliances, IEE Japan, RM-15-083/LD-15-034/HCA-15-036(2015)