

Magnetizing Technique for Permanent Magnets in IPM Motor Rotors Using HTS Bulk Magnet

T. Oka¹, S. Hasebe², J. Ogawa², S. Fukui², T. Nakano², K. Yokoyama³, M. Miryala¹, N. Sakai¹ and M. Murakami¹

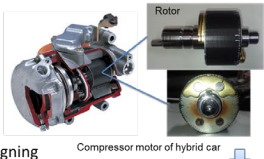
¹Shibaura Institute of Technology, 3-7-5 Toyosu, Koto-Ward, Tokyo, 135-8548 Japan

²Niigata University, 8050 Ikarashi-2-nocho, Nishi-Ward, Niigata, 950-2181 Japan

³Ashikaga Institute of Technology, 268-1 Omae-cho, Ashikaga, Tochigi, 326-8558 Japan

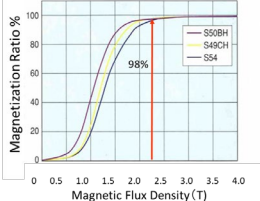
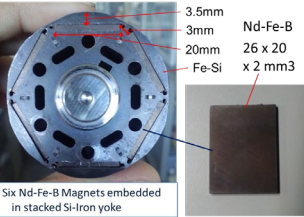
Context

- Pulsed field magnetization
 - Heat generation in pulse coils
 - Efficiency descending
 - Unsafty of coil destruction
 - Enhancement of PM performance
 - Magnetizing field over 2.5 T
 - Saturation of iron yoke to 2 T
 - Restriction of freedom degree of designing
- Utilizing of HTS BULK MAGNET
- Static magnetic field
 - No heat generation
 - Safe operation

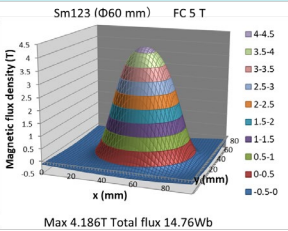
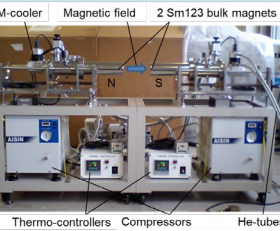


Compressor motor of hybrid car
IPM Motor Armature

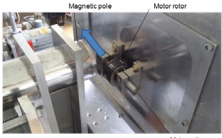
Structure of Armature of IPM Motor



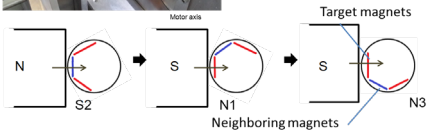
HTS Bulk Magnet



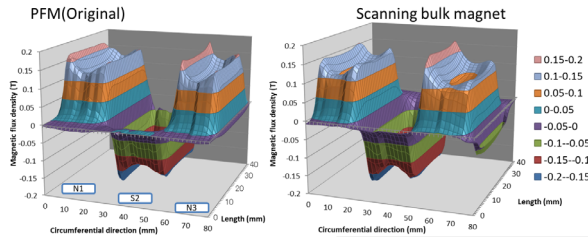
Experiments



Demagnetization at 300 C for 60 min
Scanning along horizontal
Target samples were
S2 → N1 → N3

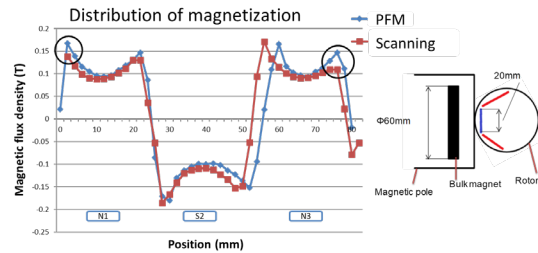


Experimental Results

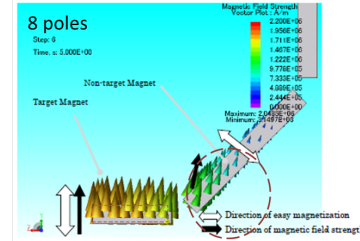
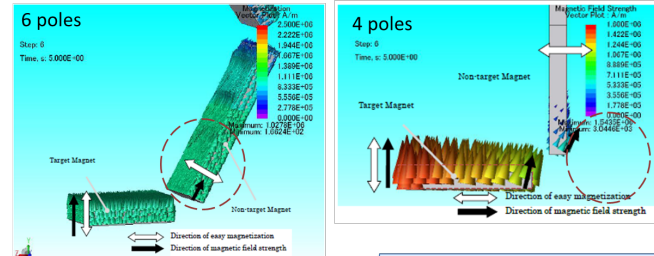


	PFM	Scanning
Max of trapped field	N1 0.169T S2 0.185T N3 0.185T	0.152T 0.190T 0.180T
Total flux	N1 54.21mWb S2 65.45mWb N3 49.94mWb	46.33mWb 65.34mWb 48.93mWb

Perfect magnetization was performed by scanning



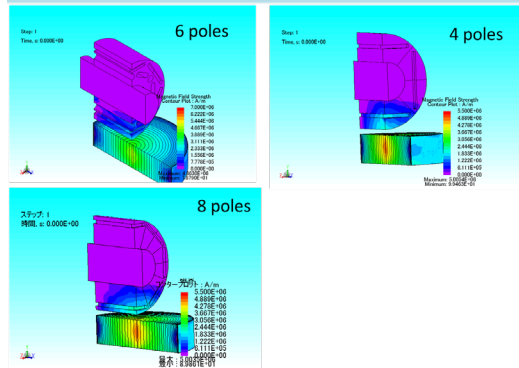
Numerical Simulation



- ✓ Target magnet was fully magnetized
- ✓ Effects of inverse field direction
- ✓ As for 6-pole, applied direction coincided to difficult direction of non-target magnet
- ✓ As for 4-pole, the magnetic field was applied to the right direction, as for 8-pole, to inverse direction

Poles	Target magnet	Non-target
4	83%	< 1%
6	Full	< 1%
8	Full	60%

Numerical Simulation (3D)



Summary

- A unique activation technique for permanent Nd-Fe-B magnets embedded IPM motors has been developed with use of HTS bulk magnet
- The sample rotor were exposed in the intense static magnetic fields above the magnetic pole containing the bulk magnet generating over 3 T
- The experimental and numerical simulation studies were conducted to evaluate the magnetic field-trapping performances
- The magnetization property of permanent magnet plates in the rotor was found to follow the magnetization curve of the material with its anisotropic magnetization property
- The sample magnets were perfectly magnetized in the static magnetic fields
- We convinced this technique should enable us to promote the degrees of freedom of motor designing and processing.