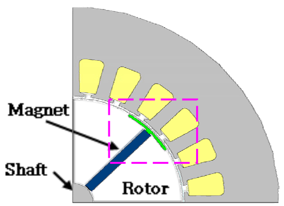
DQ13

Optimization of Novel Flux Barrier in IPM Type BLDC Motor Based on Modified Taguchi Method

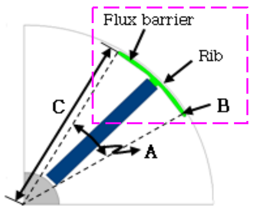
Byoung-yull Yang, Kyu-yun Hwang, and Byung-il Kwon*
Department of Electrical Engineering, Hanyang University, Ansan, South Korea
*Corresponding author: Byung-il Kwon, e-mail: bikwon@hanyang.ac.kr

The structure of a spoke type BLDC motor has a high saliency ratio that produces additional reluctance torque. However, this structure has a significant cogging torque that affects the motor operation performance levels: speed perturbation, positioning error, acoustic noise, and vibration [1, 2].

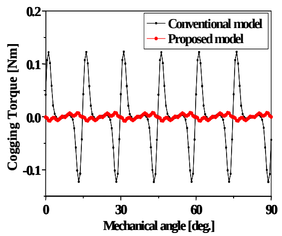
To reduce the cogging torque, this paper proposes the novel flux barrier and optimizes it by using the modified Taguchi method. The novel flux barrier can reduce the leakage flux and the cogging torque by changing the routine of flux lines. The modified Taguchi method is also utilized to consider multiple objective quality char-acteristics simultaneously such as the torque ripple, the efficiency as well as the cogging torque. Fig. 1 (a) and (b) show motor shapes of the proposed model with the flux barrier and the design variables, respectively. Three design variables are selected as the width angle of the flux barrier (**A**), the fillet of the flux barrier end (**B**) and the length from the rotor center to the edge of the flux barrier (**C**). The design variables are respectively optimized as 30 mm, 0.25 mm and 33 mm. As the optimization results, the cogging torque is reduced by approximately 93.98 %, the torque ripple is reduced by 40.66 %, and the efficiency is increased about 1.0 % compared with the conventional model as shown in Fig. 1(c) and (d).



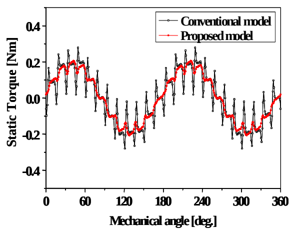
(a) Cross section of IPM type BLDC motor with novel flux barriers



(b) Selection of design variables



(c) Comparison of cogging torque waveforms



(d) Comparison of statistic torque waveforms

Fig. 1. Optimization of Novel flux barrier in BLDC motor.

REFERENCES

[1] K. Y. Hwang, *et al.*, IEEE Trans., Magn., vol. 43, no. 4, pp. 1833-1836, Apr (2006).

[2] K. C. Kim, *et al.*, IEEE Trans., Magn., vol. 42, no. 10, pp. 3485-3487, Oct (2006).

DQ14

A Passive Superconducting 3rd Harmonic RF Cavity to Increase Beam Lifetime for PLS

Y. Sohn*, I. S. Park, M. S. Hong, H. C. Kwon, and J. H. Choi
[1]Pohang Accelerator Labotrtory, POSTECH, San 31 Hyojadong, Pohang, Kyungbuk 790-784, Korea
*Corresponding author: Y. Sohn, e-mail: younguk@postech.edu

A superconducting third harmonic RF cavity is developed to increase electron beam lifetime and to confirm beam stability in storage ring of Pohang Accelerator Laboratory, POSTECH. The estimation from beam dynamics computation shows that beam lifetime is increased to factor of two at least with 1500 MHz cavity in case of beam emittance improvement to 10 nm.

With requirements of beam dynamics a shape and parameters of RF cavity are drawn using computer codes shown Fig. 1 and 2.

A passive superconducting cavity with 1500 MHz as third harmonic frequency of 500 MHz main cavity is chosen due to less space occupation and to simple installation, than a normal conducting cavity. The cavity is fabricated with deep drawing including trimming, electron beam welding, which is most reliable method. The conditioning RF surface to confirm stable accelerating electric field includes mechanical and chemical polishing, heat treatment and high pressure water rinsing.

Test and measurement are done in cryogenic environment. As shown in Fig. 3 the cavity produced accelerating field as much as 25.2 MV/m with unloaded Q, 9.2 × 10^9 at resonant frequency 1499.7 MHz.

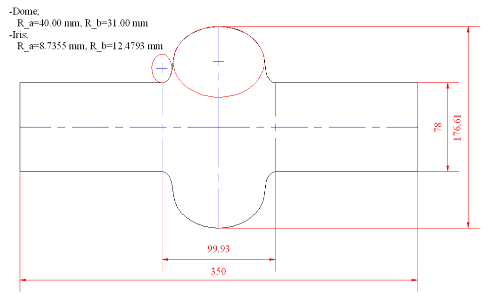


Fig. 1. Designed profile of RF cavity.

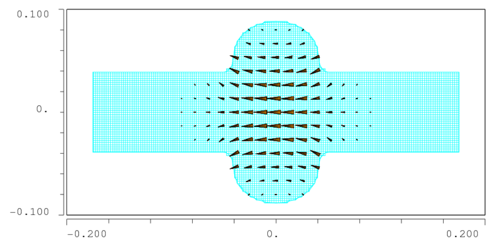


Fig. 2. Distribution of accelerating electric field.

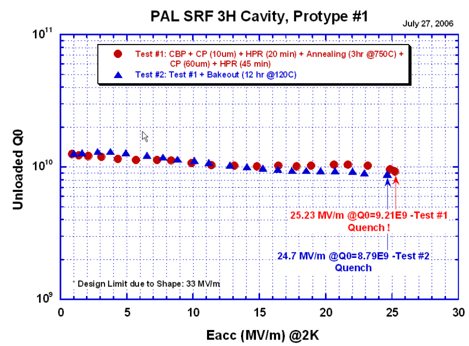


Fig. 3. Measured accelerating electric field @2K.