EQ08

Broadband RF Noise Suppression Behaviors with Aspect Ratio of Magnetic Nanowires Composite

Baekil Nam[1], Sang Kwan Lee[2], Yong-Ho Choa[3], Sung-Tak Oh[4], and Ki Hyeon Kim[1]*

[1] Department of Physics, Yeungnam University, Gyeongsan, 712-749, Korea
[2] Korea Institute of Materials Science, Changwon, 641-010, Korea
[3] Department of Chemical Engineering, Hanyang University, Ansan, 426-791, Korea
[4] Department of Materials Sci. and Eng., Seoul National University of Technology, Seoul, 139-743, Korea

*Corresponding author: e-mail: kee1@ynu.ac.kr

In order to improve the signal integrity of electronic component in radio frequency (RF) region, the conduction noise reduction is essential on signal transmission line. Therefore, we studied the noise suppression using magnetic nanowires composite on a microstrip line in the broadband radio-frequency range from 0.5 GHz to 20 GHz. The electromagnetic (EM) wave absorption in near field is deeply related with the magnetic moment and the ferromagnetic resonance (FMR) of magnetic materials, which FMR frequency can be controlled by the magnetic moment and the aspect ratio of magnetic nanowires. In order to control the frequency of EM absorption in broadband range, the magnetic nanowires were mixed with the each different aspect ratio in composite. The FMR frequencies with the change of aspect ratio were calculated by LLG eq. and the transmission power loss on microstrip line was simulated using 3D FEM HFSS simulator. The microstrip line model was composed of Cu conductor line and grounded dielectric substrates, which was designed by IEC standard (IEC 62333-2). The FMR frequency is gradually increased with the increment of aspect ratio (up to 50) of magnetic nanowire. When the magnetic nanowires were mixed with various aspect ratio in composite, the FMR frequency exhibited the broadband frequency region 10-28 GHz (4 μMs: 20 kG), 5-14 GHz (4 μMs: 10 kG), 2.5-7 GHz (4 μMs: 5 kG), and 1-2.7 GHz (4 μMs: 2 kG). Using the calculated FMR frequency profile, the power losses were obtained in broadband frequency region as shown in Fig. 1. As results, the conduction EM noise in broadband frequency region can be suppressed by the magnetic nanowires with various aspect ratio in composite.

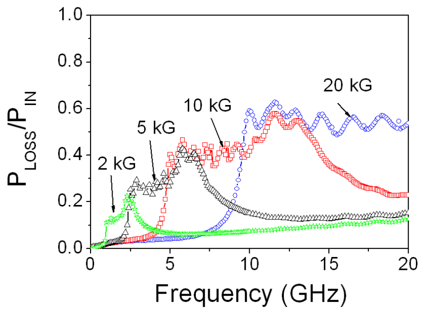

Fig. 1. The transmission power loss on microstrip line with the change of magnetization and the combined aspect ratio of magnetic nanowires composite.

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Study of Resistivity Effect on Eddy Current Loss of Powder Compressed Cores Using FEM

Bonghan Lee* and Pyungwoo Jang

Division of Applied Science, Cheongju University, Cheongju 360-764, KOREA

*Corresponding author: e-mail: volky8111@hotmail.com

Powder compressed cores have being widely used for their very low core loss and excellent dc bias permeability characteristics. However, effects of materials variables on the core loss such as resistivity of powder and insulator, particle shape are not well understood quantitatively including magnetization dynamics. In this study, effect of the insulator resistivity on the core loss of powder cores were simulated by 3-D FEM. The model cores are of rectangular toroid shape, in which 1 μm insulator were coated on 100 × 100 × 100 μm particles. Total number of the particles in the model is 396 and 9 particles were placed in rectangular cross section. The average path length is about 4.9 mm. With increasing resistivity ratio(R_ρ= ρinsulator/ ρpowder) core loss decrease dramatically and then keep a constant value when R_ρ is beyond around 10^4. This indicates that insulator with very high resistivity is not prerequisite for low core loss of the powder compressed cores. The resistivity of alumina(R_ρ= 10^{14}) times higher than that of metal. This result agrees well with the previous experimental results [1,2]. Figure 1 shows profiles of eddy current flow on the cross section of the core with different R_ρ. In the cores with R_ρ= 1, most of the current flows on surface of the core while the current reduced with increasing resistivity. Finally the current flow inside magnetic particles in the cores with R_ρ= 10^4.

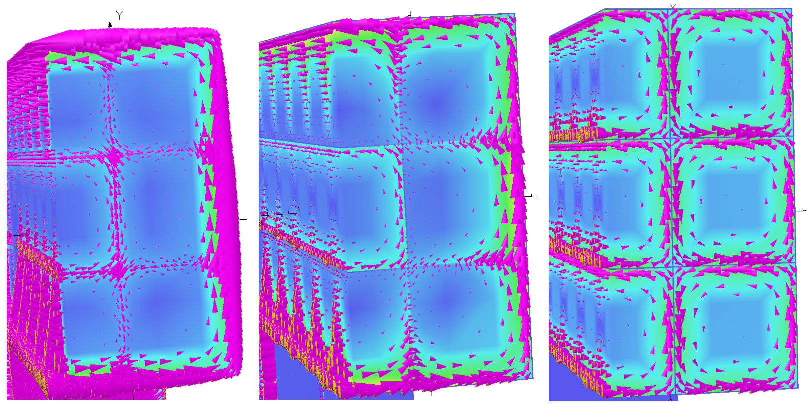

Fig. 1 Eddy current profiles of cores. (50 kHz, 90°, R_ρ= 1, 102,104.(left, center, right, respectively))

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