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Loss power properties of near field electromagnetic wave through microstrip line for magnetic layer films with different levels of electrical resistivity

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For the high performance reduction of the electromagnetic noise in a quasi-microwave frequency band, the development of magnetic materials have been progressed towards high saturation magnetization, high self-resonant frequency, and high electrical resistivity. For this study, high resistive magnetic materials such as soft magnetic crystalline or amorphous alloys and nanocrystalline thin films have been studied. The newly developed materials belong to the resistivity levels of 10 ~ 10^4 cm comparable to semiconductor materials.[1-3] The effect of resistivity on electromagnetic noise reduction in near field for the semiconducting magnetic materials needs to be investigated, because the resistivity levels of the semiconducting magnetic materials are low enough to deteriorate high frequency loss properties. In particular, electromagnetic loss behaviors of magnetic layer films in the near-field were not suggested yet.

The study presents electromagnetic loss behaviors through microstrip line attached with magnetic layer films with different levels of electrical resistivity in the quasi-microwave frequency band. The absorption and reflection characteristics of near-field electromagnetic wave without gap between microstrip line and the magnetic layer films were investigated with numerical analysis. The numerical analysis was carried out by HFSS (High-Frequency Structure Simulator) to analyze the three-dimensional distribution of electromagnetic field.

The numerical results confirmed that the loss power of the double-layer semiconducting magnetic materials is as high as 90% in the frequency range 1 GHz to 6 GHz, while the loss power of the single-layer magnetic materials is significantly lowered, depending on conductivity. The large decrease in loss power for the single-layer magnetic materials was caused by an increase of reflection of electromagnetic noise. The remarkable enhancement in loss power of the semiconducting magnetic materials was attributed to the increase in loss factor of the resistive loss, so-called, the eddy-current loss dissipated the signal energy impinge on its surface in the form of heat.

Reference

[1] Hiroshi Ono, Tetsuo Ito, Shigeyoshi Yoshida, Yasuharu Takase, Osamu Hashimoto, and Yutaka Shimada, IEEE Trans. Magn. 40, 2853 (2004).

[2] Shihui Ge, Xiaolin Yang, Kwang Youn Kim, Li Xi1, Xiaoming Kou, Dong-Sheng Yao, Binsheng Li, and Xinwei Wang, IEEE Trans. Magn. 41, 3307 (2005).

[3] Ki Hyeon Kim, Masahiro Yamaguchi, Ken-Ichi Arai, Hideaki Nagura, and Shigehiro Ohnuma, J. Appl. Phys. 93, 8002 (2003).