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FEM Analysis of Conduction Noise Attenuation by Magnetic Composite Sheets and Thin Films on Microstrip Line

Sun-Tae Kim , Gi-Bong Ryu and Sung-Soo Kim*

Department of Materials Engineering, Chungbuk National University, Cheongju 361 763, Korea

E-mail: sskim@chungbuk.ac.kr

Ferromagnetic metal particles or thin films have been proposed as the near-field noise absorbing materials in miniaturized RF circuits. Absorption loss of those magnetic materials (in the form of thin composite sheets or films) is influenced by many factors such as material parameters, frequency, and sample dimensions. Microstrip lines or coplanar lines are typically used to determine their noise absorbing capability by measuring reflection and transmission parameters (S_{11} and S_{21}, respectively). In this study, noise absorbing properties of the magnetic sheet and thin films are analyzed by using electromagnetic field simulator (Ansoft HFSS 9.0) which employs FEM (finite element method) and adaptive meshing. Microstrip line modeling is shown in Fig. 1, and composite sheets of iron flake particles and magnetic thin films (Fe-Al-O, Co-Al-O) are used as the noise absorbing materials. Boundary conditions for the modeling are given by material parameters (conductivity, permeability, permittivity, loss tangent) of signal line, ground plane, substrate, noise absorber, and air box. Port is excited by TEM-mode wave with characteristic impedance of 50 ohm. Mesh refinement is continued until solution convergence of S-parameter is within allowed value ($\Delta S < 0.02$). S-parameters (S_{11}, S_{21}) and power loss are simulated as a function of frequency with variation of magnetic materials (bulk sheet, thin films) and their dimensions (size and thickness). The simulated value is in good agreement with measured one (for example, Fig. 2) and it is suggested that the proposed simulation program can be effectively used in the design of noise absorbers used in the RF circuits.

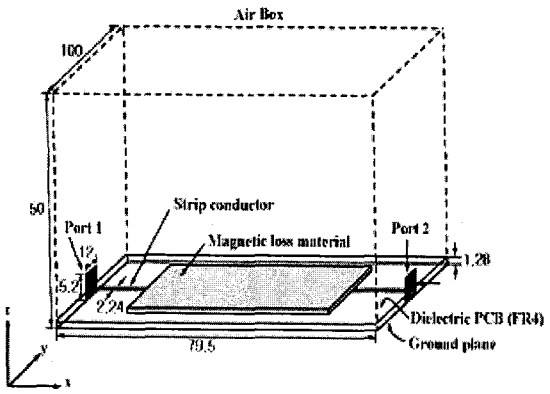

Fig. 1. Model for simulation.

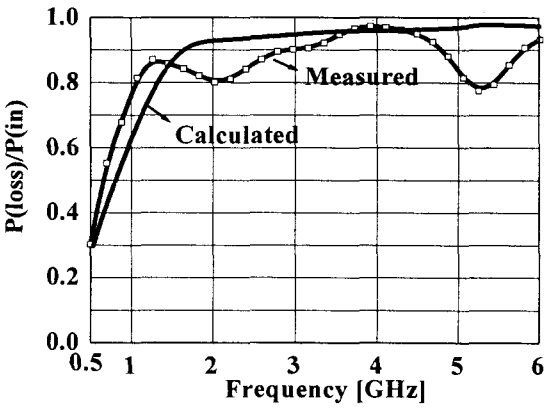

Fig. 2. Power loss of magnetic sheet.