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Finite-element method analysis on electromagnetic noise absorption characteristics of a coplanar transmission line integrated with a magnetic film

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Abstract

A finite-element method using a commercial simulation package (HFSS version 9.2.1) was applied to analyze a loss generation and electromagnetic noise absorption characteristics of a coplanar waveguide transmission line integrated with a magnetic thin film. A variation of electromagnetic noise absorption characteristics was examined with changing the electrical resistivity of the magnetic layer and the thickness of both magnetic and insulating layers. The frequency of the noise absorption peak moves toward the low frequency band as the thickness of the magnetic layer increases from 0.3 μm to 1 μm. This is because the inductance increases and the L-C resonance frequency decreases. When increasing the thickness of the SiO_2 insulating layer from 0.1 μm to 0.5 μm, the frequency of the absorption peak shifted toward the high frequency region. This is because the distributed capacitance decreases and the L-C resonance frequency increases. The noise absorption bandwidth increased as the electrical resistivity of the magnetic layer decreased, because the large eddy current loss occurred from the high frequency region. And the frequency of the absorption peak also increased within the small range. This is because the large eddy current loss decreases the permeability in the high frequency region and hence the inductance. Finally, the simulation was accomplished without setting the occurrence of the FMR. When comparing the result and that simulated with setting the occurrence of the FMR, not wide differences were observed, except for the frequency of the noise absorption peak.

In conclusion, the L-C resonance is found to be the main loss mechanism for the electromagnetic noise absorption and the FMR and eddy current losses play minor roles.