SCATTERING PARAMETERS OF MAGNETOSTATIC SURFACE-WAVE TRANSDUCERS: THEORY AND EXPERIMENT

Manuel J. Freire, Ricardo Marques*, Francisco Medina
Dept. of Electronics and Electromagnetics, University of Seville
Ave. Reina Mercedes s/n 41012 Seville, Spain

The theoretical and experimental study of the excitation of magnetostatic-surface waves (MSSW) by microstrip transducers was first reported by Ganguly and Webb in [IEEE MTT-23, 998-1006, Dec. 1975] and [IEEE MTT-26, 444-447, June 1978]. In these works, the input impedance of MSSW transducers is calculated assuming two hypothesis: uniform fields along the width of the YIG film and uniform current distribution across the strip. Later, in [T. W. O'Keeffe and R. W. Patterson, J. Appl. Phys., 49, 4886-4895, Sept. 1978], nonuniform fields are considered in an analysis based on a superposition of modes to include the effect of the finite width of the YIG film in the calculation of the delay time of a MSSW delay line. In [J. C. Sethares, IEEE MTT-27, 902-909, Nov 1979] and [S. N. Bajpai, IEEE MTT-36, 132-136, Jan. 1988] it is reported the calculation of the input impedance and the insertion loss of MSSW transducers, respectively, assuming a nonuniform current distribution on the strips. However, uniform fields are assumed in these works when the transmission line theory is applied in the analysis. In the present work, the authors show a method for the calculation of the input impedance (i.e., return loss) and the insertion loss of two-microstrips MSSW transducers not assuming the above two hypothesis. This method has two parts. In the first part, the transmission line theory is applied without disregarding the variation along the width of the YIG film and the telegrapher's equations are solved analytically. The insertion loss is then derived from the closed-form solution of the telegrapher's equations and it is obtained as a function of the width of the YIG film and the following transmission line parameters: the complex propagation constant, the complex characteristic impedance of the YIG-loaded microstrip line and the mutual inductance between the two microstrips. The input impedance (return loss) is obtained from the complex characteristic impedance, the complex propagation constant and the width of the YIG film by using an exact traslation impedance formula without approximations, that is, not assuming uniform fields. In the second part of the method, the transmission line parameters are numerically computed by applying a full-wave method of moments technique. Although a transmission line model is used, the final solution does not correspond to a quasi-TEM approach since the parameters of the model are obtained following a full-wave treatment. Thus, the scattering parameters of two-microstrips MSSW transducers comprising metal-dielectric-YIG-GGG can be computed without restrictions in the dimensions. Theoretical results are found to be in good agreement with measurements for different microstrip structures.