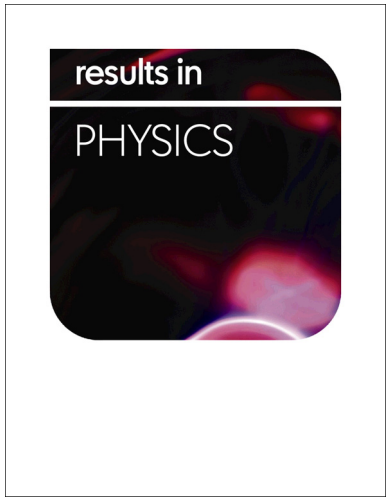

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Transverse Electric Surface Waves in a Plasma Medium Bounded by Magnetic Materials

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Abstract: The transverse electric surface waves have been investigated with a plasma medium sandwiched between two ferrite films. The characteristic equations for the field components are derived and a dispersion relation is analytically obtained by using boundary conditions for the tangential field components. Numerical analysis shows the plots of effective wave index with surface wave frequency for different thicknesses and number densities of the plasma medium, and also for the different values of the dielectric constant of the ferrite films.

Keywords:
Transverse electric surface waves, Sandwich structures, Maxwell's equations, Dispersion relation

1. Introduction

Sandwiched and dielectric slab waveguide structures have been one of the topics of theoretical as well as experimental study in both optical and microwave research. The recent progress in the study of integrated circuits and the antenna systems based on these structures played an important role in the development of communication devices [1–3]. In this context, the properties of electromagnetic (EM) guided and surface waves have been studied extensively by various authors. For example, Xu et al. [4] investigated transverse electric (TE) and transverse magnetic (TM) guided and surface modes in indefinite-medium waveguides. They discussed numerically four distinct cases for the existence conditions of guided modes. More recently, Smirnov and Valovik [5] studied the TE guided waves along a plane dielectric waveguide with Kerr-type nonlinear permittivity. In the presence of nonlinearity, they showed many interesting results for the propagation modes and compared these with the linear modes. In another study, El-Khozondar et al. [6] investigated TE surface waves in a ferrite slab, sandwiched between metamaterials. They numerically analyzed the dispersion characteristics of TE surface waves for the different parameters of metamaterials and the thickness of ferrite slab, etc. Wu [7] studied the TM surface wave in a symmetric planar waveguide consisting of a superconductor sandwiched between nonlinear antiferromagnets. They analyzed phase constant and attenuation constant in the infrared region of frequency as a function of the superconductor's thickness.

Because of the simple geometrical configuration of a slab waveguide structure, different surface and guided modes can be explained by the straightforward mathematical expressions. The propagation characteristics of EM wave transmission in a waveguide structure can be modified by using various types of materials. For the EM wave modes, a lot of research work has been done on waveguide structures in which magnetic and dielectric layers have been frequently used as common materials (e.g. [6–9]). Magnetic materials could not be used before the introduction of ferrites (around

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