Scattering of Electromagnetic Waves by Inhomogeneous Dielectric Gratings Loaded with Perfectly Conducting Strips

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The scattering and guiding problems of inhomogeneous dielectric gratings have been of considerable interest such as optical fiber gratings, photonic bandgap crystals, frequency selective devices, and other applications by the development of manufacturing technology of optical devices. Recently, many analytical and numerical methods which are applicable to the arbitrarily dielectric gratings have been proposed. However, most theoretical and numerical studies have considered the periodic structures in which the material forming grating was either metallic or dielectric.

In this paper, we proposed a new method for the scattering of electromagnetic waves by inhomogeneous dielectric gratings loaded with perfectly conducting strips using the combination of improved Fourier series expansion method and point matching method.

In the inhomogeneous dielectric region $S_2(0 < x < d)$, the permittivity profile $\varepsilon_2(x, z)$ is generally not separable with respect to the x and z variables. Main process of our methods are as follows: (1) The inhomogeneous layer is approximated by an assembly of M stratified layers of modulated index profile with step size $d_\Delta (\triangleq d/M$. (2) Taking each layer as a modulated dielectric grating, the electromagnetic fields are expanded appropriately by a finite Fourier series. (3)In the perfectly conducting strip and gap regions at C and $\bar{C}$ for the boundary, the electromagnetic fields are matched on both sides using point matching method(3) Finally, all stratified layers include the metallic regions are matched using appropriate boundary conditions to get the inhomogeneous dielectric gratings loaded with perfectly conducting strips.

Numerical results are given for the transmitted scattered characteristics for the case of incident angle both TM and TE waves.

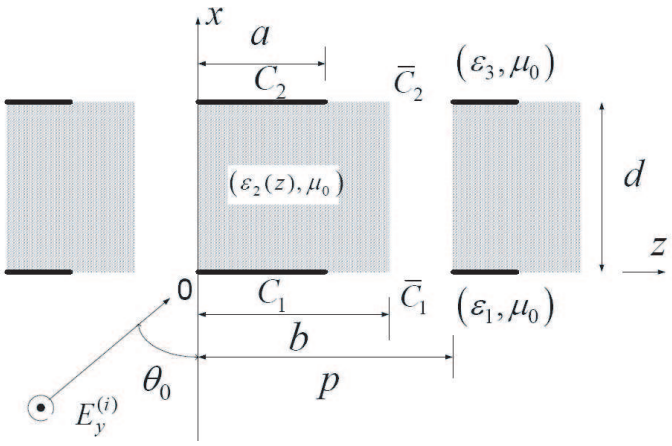

Figure 1: Structure of inhomogeneous dielectric gratings loaded with perfectly conducting strips.