Communication

A Source-Model Technique for Analysis of Waveguiding Across an Array of Arbitrary Smooth Cylinders Partially Buried in a Penetrable Substrate

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***Abstract*—A computational technique for modal analysis of an array of penetrable cylinders with smooth arbitrary cross section is described. The cylinders are partially buried between two penetrable half-space media, as may occur in fabricated device. Our suggested method is a rigorous full-wave frequency-domain source-model technique. The corner-like intersections of the cylinders with the substrate and superstrate are addressed with particular care, by intricately locating properly modulated fictitious sources, so that the rapid spatial variations of the fields can be effectively modeled. The spurious-free modal analysis scheme is sped up with an efficient serial mode-tracking scheme, which is based on the physical perturbation theory. The respective software tool is robust to the choice of materials, geometric parameters, and wavelength. Sample results are presented for circular and triangle-like cylinders. We demonstrate a red shift of the cut-off frequency of these potential waveguides as they are more deeply buried in a high refractive index medium, yet in general, the eigenmodes change rapidly but not necessarily monotonously as a function of the burial depth.**

***Index Terms*—Buried structures, computational electromagnetics, frequency-domain analysis, modal analysis, optical waveguides, periodic structures, source-model technique (SMT).**

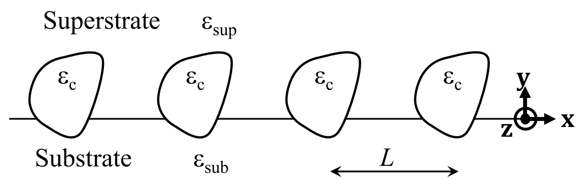

Fig. 1. Linear chain with period L along x composed of cylinders with infinite z-dimension, arbitrary smooth XY cross section, and relative permittivity ε_c. The cylinders are partially buried in a dielectric half-space substrate ($y < y_{\text{sub}}$) with relative permittivity ε_{sub}. Above lies a dielectric half-space with relative permittivity ε_{sup}.

reliable modal solvers of lossy open waveguides. IE methods for analysis of *periodic* structures, e.g., arrays of 3-D particles [20], [21], are somewhat laborious, and benefit from integrating an additional acceleration method [21], [22]. Off-surface IE methods offer a more speedy analysis of periodic structures. The generalized-