Abstracts

Electromagnetic scattering from a PBG material excited by an electric line source

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A general procedure Is presented to determine the fields scattered by a periodic structure due to a complex excitation in terms of the structure's plane-wave response. Specifically, the scattered field from an electric line source over a semiinfinite metallo-dielectric photonic bandgap (PBG) material is described. An effective description for the artificial crystal's plane-wave response is used, consisting of angularly parameterized response functions. A methodology for analyzing the electromagnetic response of such a material to a nonplane-wave excitation is provided, whereby a general complex excitation is spectrally decomposed into an integral over a continuous spectrum of homogeneous and inhomogeneous plane waves. An analytic solution for the scattering of each plane wave by the PBG material half-space is then utilized. The complete scattered field is given in a closed integral form, which is computed both numerically and in the asymptotic limit. The effect of the PBG crystal half-space on the scattered field due to an electric line source is presented for frequencies that correspond, for a normally incident plane wave, to a transmission bandgap, a transmission band edge, and an antireflecting plateau. The focusing effects and electric- and magnetic-wall behavior of the PBG crystal are demonstrated. The presented approach promotes both the physical understanding of PBG material systems and the efficiency of the numerical modeling of these systems at frequencies beyond the quasi-static limit of the traditional effective medium theories.

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