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Effective medium theory of photonic crystals[1] W.T. LU, Department of Physics and Electronic Materials Research Institute, Northeastern University, Boston, MA 02115, S. ZHANG, Department of Mechanical Engineering, University of California at Berkeley, Berkeley, CA 94720, Y.J. HUANG, S. SRIDHAR, Department of Physics and Electronic Materials Research Institute, Northeastern University, Boston, MA 02115 — We develop an effective medium theory for photonic crystals including negative index metamaterials. This theory is based on field summation within the unit cell. The unit cell is determined by the surface termination. The orientation of the surface breaks the field summation symmetry. This theory is self-consistent. The effective permittivity and permeability tensors will give the exact dispersion relation obtained from the band structure calculation. For waves incident into multilayered structures, our theory gives exact transmittance and reflectance for any wavelengths. For interface with periodic surface structures, our theory gives very accurate results for wavelength down to being comparable with the lattice spacing. By properly taking into account the multiple Bloch modes inside the photonic crystal, our theory can be made to give exact Bragg coefficients.

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