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A Nonlinear Transfer Matrix Method for Third-Harmonic Generation Modeling in a One-Dimensional Metal-Dielectric Photonic Band-Gap Structure

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In this work, a nonlinear transfer matrix method, which is simple, fast, and, accurate numerical method for nonlinear optical phenomenon modeling, has been used to develop a theoretical model of a third-harmonic generation with nondepleted pump in one-dimensional metal-dielectric photonic band-gap structures for oblique incidence. The advantage of this formalism is considering multi-reflections and interferences between all forward and backward direction components of fundamental and third-harmonic waves. The fundamental and third-harmonic field intensities, which distribute along the sample structures, have been calculated for both TE and TM modes. And conversion efficiencies have been also calculated as a function of the thicknesses of metal and dielectric layers, and incident angles of fundamental wave. With optimal incident angle and layer thicknesses, the greatest conversion efficiency of third-harmonic generation can be achieved. In addition, the plasmonic enhancement of third-harmonic generation, which is occurred because of field localization between metal-dielectric interfeces, has been examined with the proposed formalism.

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