EM waves propagation through a photonic crystal

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Electrical Engineering

August 3, 2016

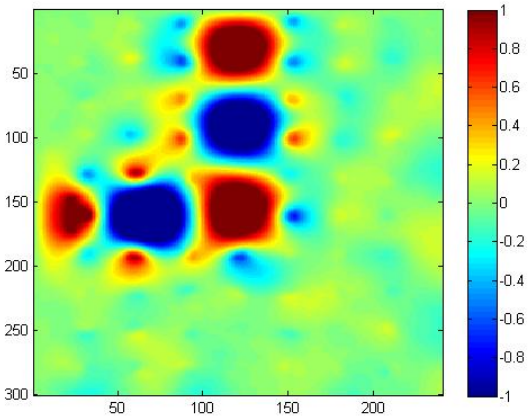
Abstract

A photonic crystal consists of an array of silicon structures. These can be modelled using squares of dielectric material in a plane. Various configurations of the crystal structures shows some interesting properties when EM waves are passed through them.

1 Wave through photonic crystal

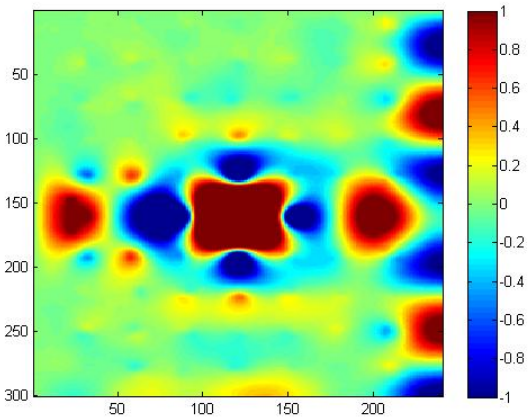
When there is a sharp bend is the usual dielectric waaveguides, the wave inside it suffers in large leakages. However, when an EM wave is passed through it, the wave can efficiently pass through any turns in the waveguide. The wave selected has a wavelength of 1.2 micrometers, and the spacing between dielectrics is 150 nm. The dielectric constant of silicon is 11.56.

The simulation is shown below:



As one can see, after running the simulation for some time, at steady state, only the empty portion of the dielectric contains the wave, and the waveguide can be bent.

When the wave is passed through a crystal with dielectric gaps in between, one can see a stationary wave being present at the center of the structure. The simulation is shown below:



2 Result and Discussion

Note that the absorbing boundary conditions have not been applied in the above simulations, yet we are able to observe the wave patterns in the grid.