

Plane Wave Expansion Method for 2D photonic crystal

Read the PWE method for 2D cases without defects :

Download the proposed files 2D_cristaux_photoniques.pdf extracted from the book Photonics Crystals [I. Sukhoivanov and I. Guryev] and PhC2Dbook.m. Limit your reading to the 2D case without defects. Try to correlate the previous 1D example with the 2D/3D formalism.

PhC with square lattice :

In this 2^d 2D example, the band structure of a 2D photonic crystal within a square lattice is calculated by solving the eigen-values of the 2D system as a function of the wave vector k . The PhC has a square lattice with side a , the Brillouin dimensions are equal to $2\pi/a$ in both k_x and k_y directions. Try to change the permittivity values and the r and a dimensions to observe the effects on the band structure and the number of bandgaps.

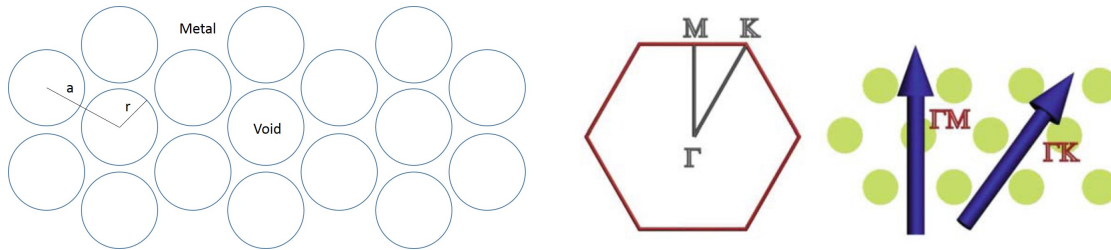


FIGURE 1 – Hexagonal lattice to be computed. Spatial arrangement (left) and the corresponding Fourier representation (right)

To do list :

- 1.) Implement the band structure calculation to plot 2D dispersion relation for an hexagonal (HCP) lattice with $r = 20$ nm and $a = 75$ nm.
- 2.) Change the $\Re(\varepsilon)$ values to calculate the band structure for a material with arrays of voids $\varepsilon = 1$.
- 3.) Implement the projection of the complete PBG obtained at different values of the PhC parameter r/a .
- 4.) Polarization analysis : Calculate and compare the band structures for TE (Transverse Electric) and TM (Transverse Magnetic) polarizations for the HCP lattice. Investigate the effect of dielectric contrast on the band gaps for each polarization.
- 5.) Present the results in 5-10 slides with discussion.
- 5.) Upload a .zip with the slides and the matlab/python files in the dedicated section in moodle.