Photonic Crystal Optical Structure Design for Current Applications

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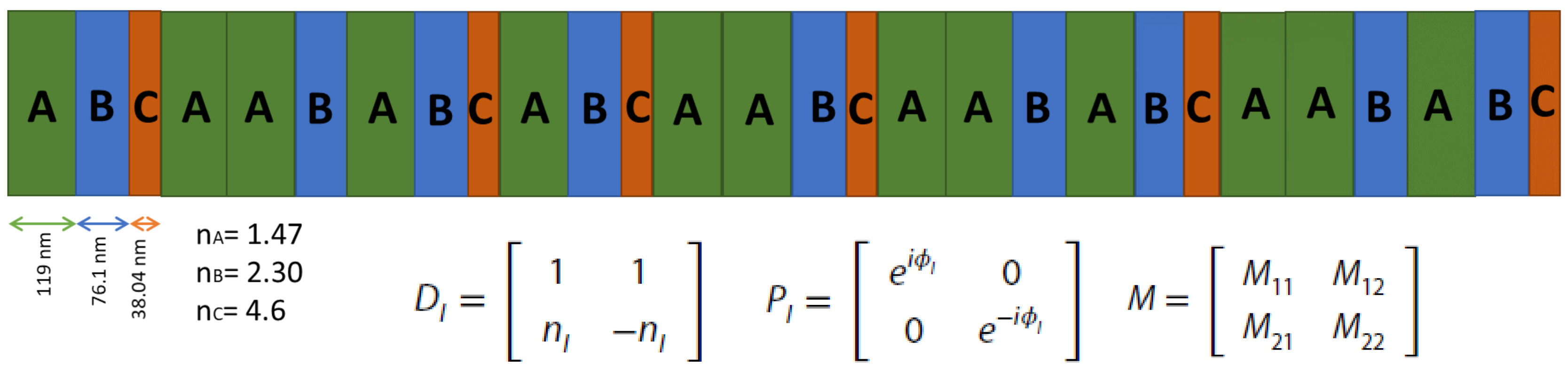
Introduction

- The main purpose of this project is designing a new type photonic crystal whose properties are unique and applicable for current applications.
- Photonic crystals have been widely searched due to its simple structure and multiple working regimes: diffraction, Bragg reflection, and subwavelength regimes. Thanks to recent development of photonic technologies and high resolution lithography photonic crystals can be demonstrated in silicon integrated devices to increase the performance.

Specifications and Design Requirements

Chosen Fibonacci Cell: S8=ABCAABABCABCAABCAABABCAABABC



n_A= 1.47
n_B= 2.30
n_C= 4.6

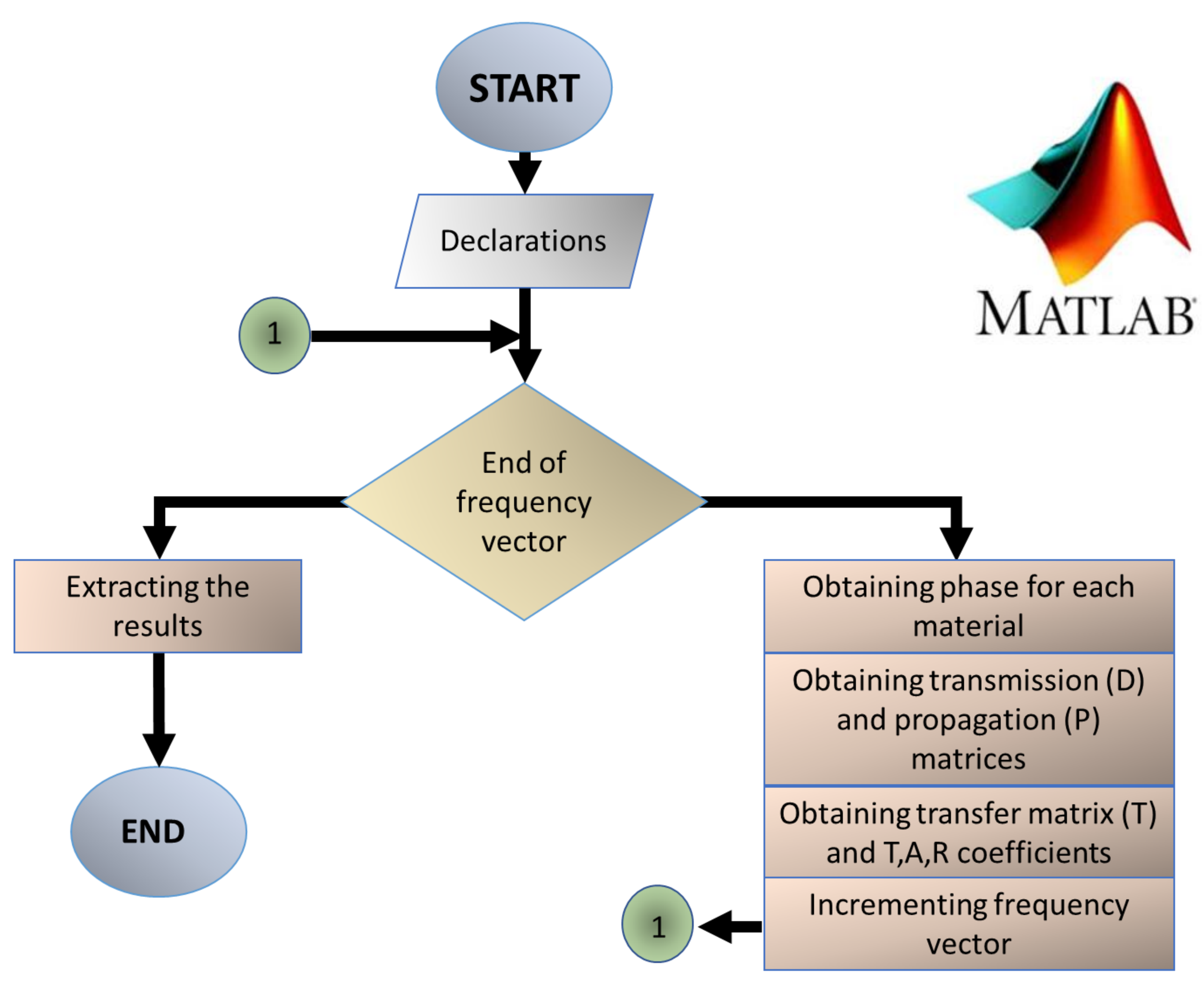
$$D_l = \begin{bmatrix} 1 & 1 \\ n_l & -n_l \end{bmatrix} \quad P_l = \begin{bmatrix} e^{i\phi_l} & 0 \\ 0 & e^{-i\phi_l} \end{bmatrix} \quad M = \begin{bmatrix} M_{11} & M_{12} \\ M_{21} & M_{22} \end{bmatrix}$$

$$A = 1 - R - T \quad \phi_l = k_l d_l = \frac{2\pi d_l}{\lambda} n_l \quad T = \frac{n_{sub}}{n_{air}} \left| \frac{1}{M_{11}} \right|^2 \quad R = \left| \frac{M_{21}}{M_{11}} \right|^2$$

Where I stands for materials A,B and C

The Related Color of the Light in Visible Region	The Wavelengths
Violet	380-450 nm
Blue	450-495 nm
Green	495-570 nm
Yellow	570-590 nm
Orange	590-620 nm
Red	620-750 nm

Solution Methodology



MATLAB

Comprehensive literature research

Learning mathematical methods Transfer Matrix Method

Determining a appropriate software to simulate

Comparing the results with previous experimental studies

Repeating the procedure until results are matched

Designing new structures in the light of scientific background

Application of Photonic Crystals

- Application of photonic crystals is various. Photonic crystals can be designed for lasers, optical insulators, perfect dielectric mirrors, LEDs, polarizers, optical filters, micron size optical benches, photonic diodes and transistors, metamaterials (negative refractive index materials), super lensing.
- In this project, a perfect dielectric mirror was succeeded that can be applied to fiber optic cables, optic filters, light sources and any area that needed a perfect reflector.

Results and Discussion

- This structure is perfect reflector except some wavelengths.
- Its absorbance in the visible region of electromagnetic spectrum is very low in the degree of Angstroms.