

ECE 695 (Numerical Simulations) – Homework 8

Due March 31, 2017 at 4:30 pm

Email to pbermel@purdue.edu

Please write your programs in C/C++, MATLAB, or Python

- 1. 1D Metamaterials** Consider a 1D metamaterial consisting of five bilayers of 10 nm silver with 150 nm air spacer layers, as depicted in the figure below.

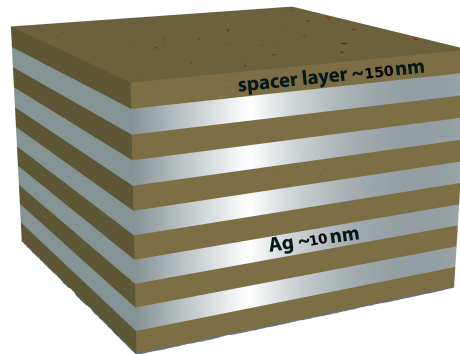


Figure 1: Schematic of a 1D metamaterial, here consisting of five bilayers of 10 nm silver with 150 nm air spacer layers.

- 1a.** Use S4 available on nanoHUB via <https://nanohub.org/tools/s4sim> to obtain the and plot the absorption of this structure for wavelengths ranging from 300 nm to 2000 nm.
- 1b.** How is this absorption spectrum different than the absorption of a silver half plane? Is this periodic structure more or less sensitive to wavelengths than the silver half plane?

2. Consider a rectangular hole lattice of air in a Silicon slab (having a dielectric constant of 12) with hole radius $r = 0.4a$, and a slab thickness of $0.55a$, where $a = 810$ nm.

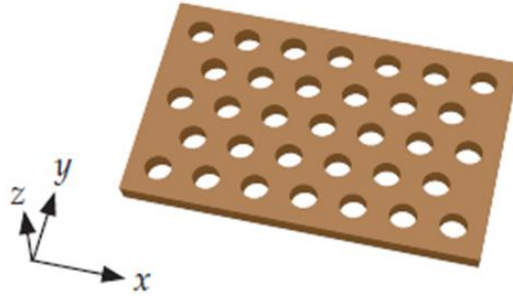


Figure 2: Photonic crystal slab to be modeled for Problem 2, with $r = 0.4a$, $t = 0.55a$, $a = 810$ nm.

- 2a. Use S4 to obtain the transmission spectrum of a single photonic crystal slab reflector in the wavelength range 1372 nm – 1653 nm with a 1 nm step, with the y-axis ranging from 0 to 1. **Hint:** increase the number of plane waves to 100 and disable smoothing of the output curve.
- 2b. What qualitative dependence does the resonant mode wavelength display with respect to the thickness t of the slab? How can this phenomenon be understood?