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Biomimetic Photonic Crystals based on Diatom Algae Frustules
JONATHAN MISHLER, Department of Physics, University of Arkansas, Fayetteville, ANDREW ALVERSON, Department of Biological Sciences, University of Arkansas, Fayetteville, JOSEPH HERZOG, Department of Physics, University of Arkansas Fayetteville — Diatom algae are unicellular, photosynthetic microorganisms with a unique external shell known as a frustule. Frustules, which are composed of amorphous silica, exhibit a unique periodic nano-patterning, distinguishing diatoms from other types of phytoplankton. Diatoms have been studied for their distinctive optical properties due to their resemblance of photonic crystals. In this regard, diatoms are not only considered for their applications as photonic crystals, but also for their use as biomimetic templates for artificially fabricated photonic crystals. Through the examination and measurement of the physical characteristics of many scanning electron microscope (SEM) images of diatom frustules, a biomimetic photonic crystal derived from diatom frustules can be recreated and modeled with the finite element method. In this approach, the average geometries of the diatom frustules are used to recreate a 2-dimensional photonic crystal, after which the electric field distribution and optical transmission through the photonic crystal are both measured. The optical transmission is then compared to the transmission spectra of a regular hexagonal photonic crystal, revealing the effects of diatom geometry on their optical properties. Finally, the dimensions of the photonic crystal are parametrically swept, allowing for further control over the transmission of light through the photonic crystal.

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