

# Siemens Competition

## Math : Science : Technology

### Regional Finalist

**Names:** Achal Fernando-Peirís

**High School:** Mount Vernon High School

**Mentor:** Frank Peiris

**Project Title:** Fabricating An Artificial Nose Using Mesoporous Photonic Crystals (Physics)

Similar to describing any color in terms of three primary colors, in a recently published medical article, scientists argued that any smell too can be described by ten primary smells. Using a self-assembly technique, silica and titania-based mesoporous photonic crystals were synthesized in order to explore if these structures produced a unique optical signal for each of the different primary smells, thus mimicking an optical nose. Several periods of silica and titania layers were spin-coated on silicon substrates in order to produce mesoporous photonic crystals. Prior to the growth of the layered structures, single layers of silica and titania were grown, and their thicknesses were determined through ellipsometry in order to develop a calibration curve relating the spin-rate and the thickness. A spectrometer, coupled to a microscope, detected the changes in the reflectivity spectra of the photonic crystals as different chemicals, each representing a different smell, were infiltrated. In order to differentiate two smells with the same index of refraction, pores were covered with different alcoxysilanes which produced a unique shift in reflectivity, forming a fingerprint for each smell. Subsequently, red-blue-green analysis was performed on digital images obtained during infiltration, which corroborates the results obtained via spectroscopy.