Fabricating an Artificial Nose using Mesoporous Photonic Crystals

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Similar to describing any particular color in the visible spectrum in terms of three primary colors, in a recently published medical article, scientists argued that any particular smell is constructed by ten primary smells. If this theory is correct, an artificially constructed nose could respond uniquely to these specific ten smells, and combine these ten responses to create the correct signature for any given smell. The goal of this project, therefore, was to create an “artificial nose” that will not only benefit human beings suffering from “smell loss”, but also be useful in smelling stale food, bombs and pollutants. Mesoporous photonic crystals, which are both porous and layered optical structures, were synthesized to mimic an optical nose. As-grown mesoporous photonic crystals produce optical responses at specific wavelengths which undergo changes subsequently, depending on the chemical that infiltrates into their pores. This is due to the changes associated with the index of refraction of the composite structure. Hence, the reflectivity of the mesoporous photonic crystal was monitored as various chemicals were infiltrated into the pores. Before the infiltration, 9-pixels of the same sample were reacted with different alcoxysilanes in order to make the chemical identities of the pores different, allowing one to differentiate two smells with the same index of refraction. Once the chemicals were infiltrated, a spectrometer showed a shift in reflectivity of each pixel, forming a fingerprint for each smell. Subsequently, RBG analysis was performed on digital images obtained during infiltration, which confirm the spectroscopy results.

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First Award of $5,000