

Physics

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Ammonia sensor based on polymer-inorganic nano-composite thin film upconversion light emitter prepared by double-beam pulsed laser deposition

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The objective of this research is to demonstrate feasibility of an ammonia sensor using polymer – inorganic nano-composite thin film upconversion light emitters made by the new double-beam pulsed laser deposition method. The existing pulsed laser deposition vacuum chamber was modified to accommodate two laser beams of different wavelengths for the in-situ ablation of two targets: A polymer host poly(methyl methacrylate) mixed with indicator dye Phenol Red and the brilliant rare earth doped upconversion phosphor NaYF₄:Yb³⁺, Er³⁺. Nano-composite films were deposited on silicon substrates by the proposed method with near-infra-red laser radiation (1064 nm wavelength) ablating the polymer target dissolved in Gamma-butyrolactone together with the indicator dye, and frozen in circulating liquid nitrogen (matrix assisted pulsed laser evaporation – MAPLE), and visible radiation (532 nm) ablating the inorganic target. The deposited nano-composite films retained bright green upconversion fluorescence with a spectral peak at 540 nm attributed to the inorganic phosphor nano-particles pumped with the 980 nm infrared laser diode. The spectrum of the green emission matched the absorption band of the indicator dye exposed to ammonia. When the films were exposed to ammonia, they demonstrated an optical response in the form of the drop of the intensity of green radiation monitored with a silicon photodiode. The sensitivity of the opto-electronic sensor of ammonia based on the nano-composite films was measured to be close 0.4% ammonia in air, and the response time was 5 minutes.

Biography

Aziz Muhammad is a junior, undergraduate research student at Dillard University in New Orleans, Louisiana. Originally from Los Angeles, Aziz has always wanted to travel to the south. So he thought what better to do than attend school there. His passion for science began at a very young age, fascinated by physics of the everyday phenomena. His research alongside Dr. Abdalla Darwish (professor and mentor) mainly focuses on pulse laser deposition of nano-composite materials. He is in his second year of research and has presented at eight different conferences, one being national. He has received multiple awards from 1st, 2nd, and 3rd place in conferences, poster competitions, and power point talks. Aziz's future career plans are to eventually obtain an engineering position for NASA or the Air Force to further extend his research and inventing.

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