Polymer-inorganic nano-composite thin film for bio, chem and light emitter sensors prepared by new double and triple -beam matrix assisted pulsed laser evaporation (D/TB-MAPLE) method

Abdalla Darwish, PhD.
Presidential professor and Ruth Simmons distinguished University professor

Abstract

The objective of this talk is to showcase the-state-of-the-art-laser educational and research facility in the physics department at Dillard University and tell the journey of building the department to be one of the top physics departments in the country producing more than 55% of African American in physics for the last 15 years. In addition, to facilitate research projects to Skyline students who might be interest in summer internship and help to understand the various types of multidisciplinary research equipment and projects on the laser labs in the physics department. In addition, this talk will give the state of multiple funded research projects from the defense which resulted in 14 papers and submitting application of five patents which changed the way the pulse laser deposition technique for fabricating the thin film is done around the world. On the other hand, we will demonstrate the feasibility of producing functional polymer nano-composite films for light emitting applications like optical sensors for toxic detection with sensitivity of $10^{-6}$ of a second. This will be used for environmental safety and public protection in addition to biosensing. The sensors are fabricated using the new innovative double and triple beam pulsed laser deposition (D/TPLD) technique. In DPLD technique, two and three laser beams of different wavelengths for the in-situ ablation of two or three targets are used to ablate a polymer host and a rare earth based highly efficient upconversion emitting inorganic dopant. Nano-composite films of acrylic polymer and nano-particles of the compounds of the rare earth elements were fabricated by the proposed method with near-infra-red laser radiation (1064-nm wavelength) ablating the polymer targets or using 2 micron and visible radiation (532 nm) ablating the inorganic targets. The fabricated nano-composite films were characterized using AFM, XRD, and optical fluorescence spectroscopy. It was discovered that the produced polymer nano-composite films retained the crystalline structure and the upconversion fluorescence properties of the initial rare earth compounds mainly due to the better control of the deposition process.