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RIR-MAPLE deposition of organic thin films for photonics and optoelectronics

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Abstract

Resonant infrared matrix-assisted pulsed laser evaporation (RIR-MAPLE) is a promising thin film deposition technology for organic materials (especially, polymers) applied to photonics and optoelectronics for two primary reasons: i) the ability to control and tune many aspects of nanoscale morphology, and ii) the ability to deposit multi-layered films, regardless of the constituent material solubilities. RIR-MAPLE is most successful when the incident laser wavelength is tuned to an absorption peak in the host matrix that is absent from the guest material. Therefore, a novel approach using target emulsions of a desired guest material and corresponding solvent with water has been developed that is compatible with a table-top Er:YAG laser. The fixed emission wavelength of the laser at 2.9 μm is resonant with hydroxyl (O-H) bonds. This approach is especially useful due to the fact that most polymers of interest and many compatible solvents do not resonantly absorb the laser energy at 2.9 μm, yet the emulsion with water enables high-quality, thin-film deposition with minimal photochemical and structural degradation. This emulsion RIR-MAPLE technique has been used for the thin film deposition of a variety of conjugated polymer and hybrid nanocomposite material systems. Of particular interest is the application of organic materials to photonics and optoelectronics. Examples of RIR-MAPLE-deposited films to be presented include blended polymer films for optical coatings, hybrid nanocomposite films for solar cells, and light-activated biocidal films for antimicrobial applications.

Biography

Wangyao Ge received his B.S. and M.S. degrees both in Material Science and Engineering from Wuhan University of Technology, China (2009) and the University of Florida, Gainesville (2011). He is currently a third year Ph.D. student in Electrical and Computer Engineering at Duke University. His research interests encompass developing novel polymer thin film deposition technology called resonant infrared matrix-assisted pulsed laser evaporation (RIR-MAPLE) for various applications including organic photovoltaics, antimicrobial surfaces as well as hybrid functional films.