SEMINAR

Mechanical Engineering & Materials Science

"Hybrid Thin Film Deposition by Matrix-Assisted Pulsed Laser Evaporation"

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Thursday, February 1
2:45 – 3:45 PM
Brauer Hall, Room 12

Abstract
Future applications, such as wearable electronics, flexible/transparent displays, or solar energy conversion/storage devices, require materials with more versatility, integrated functions, and environmentally-responsible processing compared to traditional inorganic semiconductors. Organic semiconductors are well-suited to these requirements; however, their electrical properties and environmental stability are worse. Hybrid materials could mitigate these trade-offs. For example, hybrid materials can impart multi-functionality, flexibility, transparency, and sustainability to devices based on the interaction of light and matter (i.e., optoelectronic devices) or energy-related devices (e.g., solar cells, supercapacitors, or photo-electrochemical cells). A critically important requirement to realize the promise of hybrid materials for devices is to understand and control thin film deposition. Because hybrid materials are heterogeneous systems containing more than one component, thin-film deposition can be complicated compared to single component films. As a result, the co-deposition of two or more materials with different properties to synthesize a hybrid film with pre-determined functionality is a technological challenge within thin-film engineering. In my talk, I will describe organic and hybrid thin film deposition using matrix-assisted pulsed laser evaporation to control structure and properties and to improve the performance of optoelectronic and energy-related devices.

Specifically, one variation of the technique is presented: resonant infrared matrix-assisted pulsed laser evaporation (RIR-MAPLE), which uses a low-energy IR laser to minimize degradation of organic components. In addition, the frequency of the IR laser energy is resonant with hydroxyl bond vibrational modes such that a frozen emulsion (guest material dissolved in an organic solvent and water) can be used as the target. The unique advantage of this emulsion-based RIR-MAPLE is that energy from the IR laser is absorbed by water in the frozen emulsion, which evaporates and gently transfers the guest material to the substrate with minimal solvent exposure and degradation. The development of emulsion-based RIR-MAPLE for polymer and hybrid nanocomposite films will be described, as well as recent results related to hybrid perovskites.

Biography

Adrienne D. Stiff-Roberts is Associate Professor of Electrical and Computer Engineering at Duke University, and she currently serves as the Director of Graduate Studies for the new University Program in Materials Science and Engineering. Dr. Stiff-Roberts received both the B.S. degree in physics from Spelman College and the B.E.E. degree in electrical engineering from the Georgia Institute of Technology in 1999. She received an M.S.E. in electrical engineering and a Ph.D. in applied physics in 2001 and 2004, respectively, from the University of Michigan, Ann Arbor. Dr. Stiff-Roberts received the David and Lucile Packard Foundation Graduate Scholars Fellowship and the AT&T Labs Fellowship Program Grant from 1999-2004. She is a recipient of the National Science Foundation CAREER Award (2006), the Office of Naval Research Young Investigator Award (2007), the IEEE Early Career Award in Nanotechnology of the Nanotechnology Council (2009), and the Presidential Early Career Award for Scientists and Engineers (2009). Dr. Stiff-Roberts was also an invited speaker at the National Academy of Engineering (NAE) EU-US Frontiers of Engineering Symposium in 2016. She is a member of Phi Beta Kappa, Sigma Pi Sigma, the Materials Research Society, the National Society of Black Physicists, the American Physical Society, the American Chemical Society, and the American Vacuum Society, and she is a senior member of IEEE.

Faculty, students, and the general public are invited. A light reception will precede the seminar outside of Brauer 12.