Announcing the Final Examination of Sarmad Alhasan for the degree of Doctor of Philosophy

Time & Location: June 30, 2017 at 10:00 AM in HEC 450
Title: SPRAY-DEPOSITED TITANIUM-OXIDE FILMS FOR INFRARED OPTICS, PHOTONICS AND SOLAR CELL APPLICATIONS

Self-assembled TiO₂ foam-like films, were grown by the water based Streaming Process for Electrodeless Electrochemical Deposition (SPEED). The morphology of the 1 m thick films consists of a tangled ropy structure with individual strands of 200 nm diameter and open pores of 0.1 to 3 micron dimensions. Such films are advantageous for proposed perovskite solar cell comprising CH₃NH₃PbI₃ absorber with additional inorganic films as contact and conduction layers, all deposited by SPEED. Lateral film resistivity is in the range 20 - 200 kΩ-cm, increasing with growth temperature, while sheet resistance is in the range 2 - 20 10⁸ Ω/Sq. X-ray diffraction confirms presence of TiO₂ crystals of orthorhombic class (Brookite). UV-vis spectroscopy shows high transmission below the expected 3.2 eV TiO₂ bandgap. Transmittance increases with growth temperature. This is a Ropy TiO₂ thin film. We prepared Smooth TiO₂ and Evaporated TiO₂ thin film. Self-assembled TiO₂ film deposited by aqueous-spray deposition was investigated to evaluate morphology, crystalline phase, and infrared optical constants. The 130 nm thick film has Anatase nano-crystalline structure with 10 nm characteristic surface roughness sparsely punctuated by defects of not more than 200 nm amplitude. The film is highly transparent throughout the visible to wavelengths of 12 μm. The optical band gap was determined to be 4.18 eV. Important for long-wave infrared applications is that dispersion is weak compared with the more commonly used dielectric in planer structures SiO₂. The low-cost, large-area, atmospheric-pressure, chemical spray deposition method would allow conformal fabrication on flexible substrates for long-wave infrared (LWIR) photonics.

Major: Electrical Engineering

Educational Career:
Bachelor’s of Laser Engineering , BS, 2003, Electrical & Electronics Eng./Laser Eng., University of Technology, IRAQ.
Master’s of Laser Engineering , MS, 2008, Laser & Optoelectronics Eng./Laser Eng., University of Technology, IRAQ.

Committee in Charge:
Robert Peale, Chair, Physics
Kalpathy Sundaram , Co-Chair, Electrical & Computer Engineering
Wasfy Mikhaell, Electrical & Computer Engineering
Reza Abdolvand, Electrical & Computer Engineering
Aravinda Kar, Optics & Photonics

Approved for distribution by Robert Peale, Committee Chair, on June 12, 2017.

The public is welcome to attend.