University of Central Florida

PV Devices Research and Development Laboratory

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Description: The goal from this project is to develop and equip a PV devices R & D laboratory which would then be open to industry, research institutions and academic partners for the purposes of planning, designing, deploying and operating PV systems. The new PV Devices Research and Development Laboratory is a comprehensive suite of scientific tools for the fabrication and characterization of materials and PV devices. The laboratory is located in a new PV laboratory room at FSEC and is designed specifically to reduce time delays associated with transferring technology from the academic research laboratory to industry. Furthermore, the PV laboratory will also facilitate undergraduate and graduate internship programs to train chemists, physicists and engineers in photovoltaic processing, characterization and testing.
Budget: $450,250
Universities: UCF/FSEC
Executive Summary

This project developed and equipped a photovoltaic devices laboratory which is now open to industry, research institutions and academic partners for the purposes of prototyping PV devices. Research and development is crucial for the advancement of PV, given the national goals of less than $1.00 per watt installed. Performing joint PV research and addressing well-chosen research issues can play an important role in achieving the critical mass and effectiveness required to meet the sector's ambitions for technology implementation and industry competitiveness.

In the FSEC PV Devices Research and Development laboratory, researchers used established fabrication and characterization techniques to develop new in-situ diagnostics tailored for the specific growth and processing steps used in PV manufacturing. The following customized capabilities were realized in the PV Devices Research and Development Laboratory:

1. Dimatix nanomaterials injector printing system-- The largest and most expensive item of fabrication equipment is the material printing system (Dimatix, Inc). It is a system used for inkjet- printed quantum dot and nanostructure hybrid PV and TE materials and devices. The system provides a high degree of fabrication accuracy and reliability of fabrication when operated and maintained correctly.

2. Two plasma chemical vapor deposition systems for fabrication of nanorods and controlled size and shape nanostructures -- Spin coating systems are a common tool in semiconductor fabrication labs and facilities. They allow for a controlled deposition of liquid phase materials. The Laurell Technologies system features an automated dispense system, which allows for better control of the fluid during deposition, therefore better control of the final thickness.

3. Organic/inorganic solar cell fabrication unit using fully enclosed XYZ tabletop normal and ultrasonic spraying system -- Inkjet printing is used to create the actual solar absorber, which is the layer in a solar cell in which the sunlight's energy generates free electrons. The inkjet printing technique can be applied to any thin-film materials or organic photovoltaics.

4. Customized Oriel external and internal quantum efficiency system -- The quantum efficiency (QE) system is an essential tool for any laboratory working on PV materials and devices. With

the help of Oriel's product engineers, FSEC's researchers have configured this system to measure internal quantum efficiency (IQE).

5. Oriel Class 3A solar simulator for characterization of novel developed solar cells -- In the context of PV materials and device research, a solar simulator allows for a dependable measure of device performance under broadband radiation that is spectrally similar to that coming from the sun. The configuration and operation of this system has included the fabrication of a suitable structure for safely mounting the simulator on the laboratory bench, installing individual components (e.g. light source, power supplies, optical filters, etc.), verifying proper beam alignment and light throughput, and testing the unit with actual PV cells with known current-voltage characteristics.

6. Other instrumentation and lab equipment --UV-Vis-NIR spectrophotometers and refractometers for optical analysis and in-situ electro-optical characterization techniques tailored for the specific growth and processing steps used in PV manufacturing like spectroscopic ellipsometry, photoluminescence, photocurrent decay, fourier transform infrared, and Ramen scattering, and indoor and outdoor I-V curve tracers.

   In addition, the PV laboratory will also facilitate undergraduate and graduate internship programs to train chemists, physicists and engineers in photovoltaic processing, characterization and testing.

   This Project has been completed. Final report here.