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Reliability of Photovoltaic Cells, Modules, Components, and Systems II

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Editors

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Introduction

Development of a sustainable renewable energy source is the need of the day and photovoltaic (PV) technology has a very important role to play in this effort. With the increasing concern over high carbon emission and the effects of global warming and the high fuel prices, the need for establishing PV as the alternative source of energy has become of paramount importance. For any technology to sustain, it is absolutely essential that the product be reliable and that it operates properly over its useful lifetime.

The Reliability of PV Modules session of the SPIE 2008 Optics and Photonics event was the first step in achieving the reliability and long term durability of PV modules. This effort was taken further during the SPIE 2009 Optics and Photonics event where a platform was provided, through a two day session on reliability of PV modules, for PV researchers from various companies, national laboratories, and universities to discuss their research.

Twenty-nine papers were presented and twenty-seven papers were published for this conference. The conference was divided into one plenary session, seven oral sessions, and one poster session extending over a four-day period from 3–6 August 2009. Session one, titled Metrology and Certification, had interesting presentations discussing development of UV light sources, the effect and accurate measurement of mechanical loads such as wind loads and establishing a standard protocol for preconditioning and stabilizing thin film PV modules prior to testing.

One of the talks during the plenary session by Sarah Kurtz, titled Photovoltaic-Reliability R&D toward a Solar-Powered World, discussed the importance of reliability as well as the necessity to study the reliability aspect of PV modules in order to develop PV technology as one of the major source of energy in the world.

With higher efficiencies achieved by III-V single junction and multi-junction cells, the topic of session two, Reliability of Concentrator Cells and Optics, was garnering a lot of interest. This session was a joint session with conference 7407: High and Low Concentrator Systems for Solar Electric Applications IV. Research work on the reliability of the concentrator optics and cells as well as various testing techniques and models was discussed during this session.

A good packaging scheme means an improved reliability of PV modules. Encapsulants and backsheets are two of the widely researched materials of the packaging scheme. Session three discussed various encapsulant and backsheet materials as well as various techniques to determine the lifetime of these materials.

Session four, titled Stability and Degradation Processes in Organic Solar Cells, was held as a joint session with conference 7416: Organic Photovoltaics X. Another aspect that needs attention towards establishing PV as a sustainable alternative source of energy is the reliability of the balance of system (BOS) components.

Session five, titled Reliability of BOS Components and PV Systems, had presentations discussing BOS components such as inverters, junction boxes, as well as PV systems as a whole.

The market share of thin film PV is increasing by the day; however, there is not enough understanding of some the key issues involved with reliability of thin film PV modules. The degradation mechanisms in thin film PV modules are different from that in c-Si PV and need to be understood to improve the processing techniques and eventually the reliability of PV modules. Session six discussed various issues involved in reliability of thin film PV modules.

Accelerated testing tackles the issues of infant mortality of PV modules; however, there is a need to carry out field testing of various PV technology modules in order to determine the useful lifetime and to estimate the degradation rates for various technologies. Session seven had several presentations discussing various methods to carry out long term reliability testing of PV modules and the need for a combined, sustained, and symbiotic effort among various universities and PV manufacturers to develop a program that allows the growth of the PV community as a whole.

As part of this conference a short course on design and reliability of photovoltaic modules was offered. The course was well attended and appreciated by the attendees. The focus of the tutorial was on various packaging configurations, application of concepts of physics of failure to PV systems with several examples, development of accelerated tests for various technologies, and the application of this knowledge in development of new products and technologies such as organic PV.

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