Johannes Hepp et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
DOI: 10.4172/2469-410X-C1-017

Automatized optical quality assessment of photovoltaic modules

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Optical measurement techniques open the door to a wide variety of quality inspection tools. However, the number of customizable settings, like e.g. excitation sources or optical filters, is immense. For the quality inspection of thin film photovoltaics, we developed a Matlab based analysis tool in order to investigate as many parameters-potentially obtained by different metrology methods-as possible, in a fast and reproducible way. This tool automatically executes procedures like peak wavelength detection of luminescence spectra (an indicator for material composition), hot spot detection in IR images (an indicator for recombination losses) and many mathematical combinations of multiple images taken under varying conditions. One application of this approach was to separate the effects of material composition from the influence of the defects on the performance of a photovoltaic module. The combination of these two performance indicators showed a good correlation to the open circuit voltage of the device, proving the relevance of this analysis approach. Furthermore, the tool was capable of capturing further refinements following from hardware improvements like the combination of images taken with special IR filters. This allowed us to combine the benefits of spectral and spatial resolution, which could be used in order to selectively identify certain chemical substances and their distribution in the sample of interest. The software applies the scripted processing tasks successively on all samples of a measurement series within minutes, thus enabling high throughput inline measurements. The implemented graphical user interface (GUI) allows for a flexible and user definable handling.

Biography

Johannes Hepp has completed his MSc in Material Science from Friedrich-Alexander-University Erlangen-Nuremberg (FAU) and started working on his PhD as Reseacher at Bavarian Center for Applied Energy Research (ZAE Bayern) in February 2015. He is a Doctoral Researcher at the School of Advanced Optical Technologies Erlangen (SAOT) and has authored/coauthored three publications.

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