

Thermographic detection of defects in photovoltaic panels by using optical thermography

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Lock-in thermography is one of the methods in infrared non-destructive testing, which has already been widely used in the detection of defects in various materials. Defects in photovoltaic panels can reduce the effective working area, and decrease the performance of the photovoltaic panels. Therefore, it is significant to identify such defects and to feed the fault information up to the production chain. In this paper, a thermographic detection of the defects in photovoltaic panels by using optical lock-in thermography was proposed. The front surface of the photovoltaic panel was optically stimulated in square wave and sinusoidal heating way by halogen lamp, while an infrared camera was employed to record the temperature response of the front surface. The techniques of background subtraction, discrete Fourier transform and principal component analysis were used to process the image sequences, focusing on enhancing the defect signatures. As a contrast, a similar experiment with the optical stimulation of LED lamps was also conducted. The results show that the optical lock-in thermography combined with suitable data processing is a fast and effective technique to identify the defects in photovoltaic panels. The defect inspection result of the thermography using square wave modulated stimulation is better than that of the thermography using sinusoidal modulated stimulation. PCA is better in improving the optical thermography of the PV panel stimulated by square wave modulation than by sinusoidal modulation. Among the first several principal component images, the 1st and 2nd ones are the most valuable images for the detection and location of the fault cells respectively. FFT is more suitable for the optical thermography of the PV panel stimulated by sinusoidal modulation than by square wave modulation. The halogen lamp, as a light source, is very suitable for the optical stimulation of photovoltaic panels, while the LED lamp is not applicable for inspection of photovoltaic panels.