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Interpretation of Spectral Electroluminescence Images of Photovoltaic Modules

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Abstract content
   (Max 300 words)
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Electroluminescence (EL) is a useful solar cell and module characterisation technique as it is fast, non-destructive and sensitive to the effects of shunt and series resistance and recombination parameters. A solar cell in normal operation receives an optical input in the form of the incoming light and outputs an electrical current. EL occurs when a solar cell is forward biased receiving an electrical input and outputs an emission spectrum. The emission spectrum from indirect band-gap materials like silicon is in the infrared region of light. The intensity of the luminescence emitted is related to the applied voltage and the quantum efficiency of the cell material. The spectrum of the emitted luminescence is related to cell material properties such as surface reflectance, minority carrier diffusion length and carrier lifetime.
For EL imaging a silicon CCD camera is commonly used because it has very good spatial resolution, however, this sensor is only sensitive to wavelength in the range of 300-1200 nm. There is an overlap in wavelengths from about 900 to 1100 nm allowing the EL to be detected. The spectrum of the detected EL is thus dependant on the sensitivity of the camera, the transmission of the filters and the emitted photon flux. In this study the voltage is assumed to be constant across a cell and the spectrum of the emitted EL is investigated. Short pass filters are used to cut off the emitted EL spectrum at 900nm and 1000nm. The ratio of images obtained with different filters provides a spectrally defined EL image. The effect of different short pass filters and minority carrier diffusion length on the EL spectrum is theoretically modelled. These results are compared with the experimentally obtained EL images.

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Level for award
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PhD

Main supervisor (name and email)
and his / her institution

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