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Development of CTJ Cell Characterisation Techniques for HCPV Modules

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Abstract content
   (Max 300 words)

High concentration photovoltaic (HCPV) systems utilize non-imaging optics to concentrate and distribute the solar flux uniformly onto a solar receiver to achieve maximum performance and power output from a HCPV module. However, during the manufacturing process individual concentrator triple-junction (CTJ) cells may differ somewhat in terms of their device characteristics due to latent defects. The CTJ cell unit, which includes the CTJ cell, the optical elements and thermal control elements, may also differ in energy performance due to small perturbations.

In HCPV modules where the CTJ cell units are electrically connected in series, the characterisation of each CTJ cell unit is critical to avoid severe cell mismatch effects. Several techniques were developed to characterize the CTJ cells as well as cell units. These techniques include: Visual inspection of the CTJ cell with an optical microscope to identify imperfections on the cell surface such as the formation of bubbles in the transparent protective laminate coating and indentations on the surface. The use of electroluminescence to identify regions of low carrier recombination and/or cracks within the CTJ structure. One-sun current-voltage (I-V) characterization of the CTJ cell to extract device and performance parameters to compare with the manufacturers' specification. Optical characterisation of the cell unit in terms of the illumination intensity profile on the cell surface.

This paper discusses the results and showed that using the above methods help to group similarly performing cell units within a series string in an experimental HCPV module. Under performing CTJ cells were excluded from use in the cell units. The best performing cell units were included in the experimental HCPV module. During the four-month operational test period, the cells in the experimental HCPV module showed no significant decrease in performance under outdoor operation.

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