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# Detection of Cell Mismatch in Photovoltaic modules using Electroluminescence imaging

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Electroluminescence (EL) is a useful characterisation technique as it is fast, non-destructive and allows defects in photovoltaic (PV) cells and modules to be identified. The intensity of the emitted EL is proportional to the material, recombination and resistive properties of the cell. EL imaging is very effective in detecting cell defects in modules such as cracks, broken fingers and broken cells. These defects have been shown to influence the power output of the modules proportional to the area affected. However, an EL classification scheme also needs to include the effects of cell mismatch due to Potential Induced Degradation (PID), Light Induced Degradation and poorly sorted cells. This cell mismatch is visible in the EL image as non-uniform EL intensity, where cells in the module appear darker or brighter than surrounding cells. This feature is not easy to visually identify and thus an image processing routine has been developed to identify non-uniform PV modules by mapping the variation in EL intensity.
In this study of a large number of EL images and the corresponding maximum power (PMAX) results have been used to assess the effects of cell mismatch on the performance of the module. This allows non-uniformity criteria to be developed that relates the non-uniform EL intensity of cells to the power output. Cell mismatch, visible as non-uniform intensity between cells is shown to be a contributing factor to power losses and an indication of module degradation.
This study produces a classification system that can be automatically assess EL images and can be applied to future research into the causes and effects of PID and other degradation in PV modules. This paper presents the classification criteria for cell mismatch and an analysis on the EL images in comparison with the measured power compared with the nominal power of the module.

## Summary

Electroluminescence (EL) is a useful characterisation technique as it is fast, non-destructive and allows defects in photovoltaic (PV) cells and modules to be identified. The intensity of the emitted EL is proportional to the material, recombination and resistive properties of the cell. EL imaging is very effective in detecting cell defects in modules such as cracks, broken fingers and broken cells. This study produces a classification system that can be automatically assess EL images and can be applied to future research into the causes and effects of PID and other degradation in PV modules. This paper presents the classification criteria for cell mismatch and an analysis on the EL images in comparison with the measured power compared with the nominal power of the module.

## Apply to be<br> considered for a student <br>   award (Yes / No)?

No

## Level for award<br> (Hons, MSc, <br>   PhD, N/A)?

N/A

## Main supervisor (name and email)<br>and his / her institution

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## Would you like to <br> submit a short paper <br> for the Conference <br> Proceedings (Yes / No)?

No

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