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Focused Ion Beam Imaging of Induced Defects in Polycrystalline Silicon Solar Cells

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Potential induced degradation (PID) is expected to cause both morphological and crystallographic damage in polycrystalline silicon (poly-Si) solar cells due to its microstructure and inherent grain boundaries. Formation of hotspots is caused, more often than not, from under-performing solar cells connected in series with other cells. This may be a result of mismatching during the batching stage of assembly, inconsistent anti-reflective coating, uneven degradation of the encapsulating material due to UV exposure, moisture ingress and even something as benign as a falling leaf.

For this study we have intentionally mismatched a cell in a polycrystalline cell string to induce hotspot formation. I-V measurements confirmed the mismatch in the cell string while infrared thermography confirmed the formation of hotspots. The targeted (mismatched) cell was then isolated from the string for further analyses. The first step was to identify the damaged regions on the cell and establish the Si vibrational modes in the damaged regions as compared to that of the un-damaged regions through Confocal Raman Spectroscopy. SEM analysis revealed that hotspots were formed since carbon was prevalent in the observed damaged regions. Focused Ion Beam (FIB) analysis allowed the systematic, controlled removal of layers of pre-determined thickness to establish whether indeed the p-n junction structure still exists within these damaged regions. Results obtained show that once the junction breakdown voltage of polycrystalline Si is reached, catastrophic changes in both the morphology and crystallography of the cell can significantly reduce the power producing capability of the cell. The final paper will present these results in detail through FIB imaging.

Keywords: Polycrystalline Silicon Solar Cells, Hotspot Formation, Morphological and Crystallographic Damage, Focused Ion Beam

Apply to be considered for a student award (Yes / No)?

Yes

Level for award (Hons, MSc, PhD, N/A)?

PhD

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

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

Yes

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