SEM Analysis as a Diagnostic Tool for Photovoltaic Cell Degradation

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The importance of scanning electron microscopy (SEM) analysis as a diagnostic tool for analyzing the degradation of a polycrystalline Photovoltaic cell has been studied. The main aim of this study is to characterize the surface morphology of hot spot regions (degraded) in photovoltaic solar cells. In recent years, production of hetero-junction and multi-junction solar cells has experience tremendous growth as compared to conventional silicon (Si) solar cells. Thin film photovoltaic solar cells generally are more prone to exhibiting defects and associated degradation models. To improve the lifetime of these cells and modules, it is imperative to fully understand the cause and effect of defects and degradation models.

The objective of this paper is to diagnose the observed degradation in polycrystalline silicon (poly-Si) cells, using scanning electron microscopy (SEM). In this study poly-Si cells were characterized before and after reverse biasing. The reverse biasing was done to evaluate the cells' susceptibility to leakage currents and hotspot formation. After reverse biasing, some cells were found to exhibit hotspots as confirmed by infrared thermography. The surface morphology of these hotspot regions were then characterized using SEM. Preliminary results indicate that hotspots are formed in the regions of high inhomogeneity. Energy dispersion x-ray spectroscopy (EDX) also indicates that these regions have high levels of transition metals. The final paper will provide a detailed analysis of the observed degradation.

In the paper we presented our preliminary findings. We were able to detect regions of localized heating in polycrystalline cell, and link this to hot spot formation. With the help of flying meter, hot spot Centre were mark, and carefully cut out for SEM and EDX analysis. This was done to study the effect of hot spot on the surface morphology of the cell, why the EDX helps to give detail information concerning the elemental composition of the affected area. Figure 1 shows excessive damage of the cell and high amount of carbon and oxygen, while figure 2 has fine crystal structure with low quantity of carbon and oxygen.

Acknowledgement:

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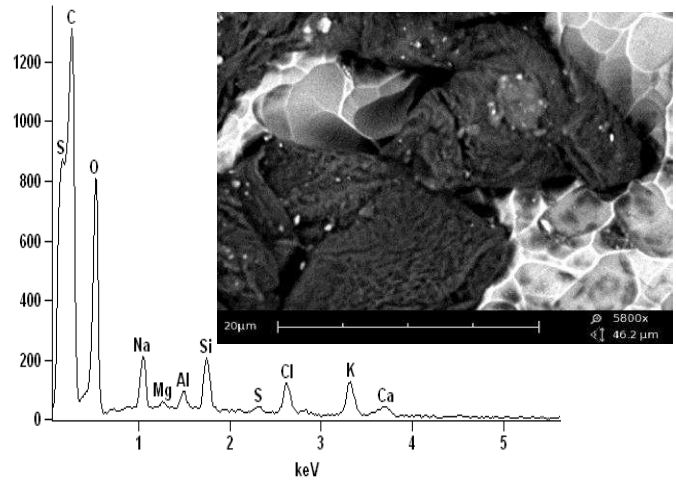

Figure 1: SEM and EDX analysis result for the affected region

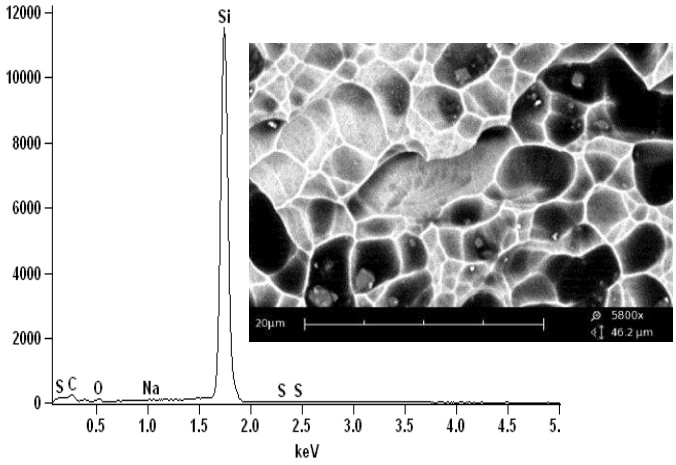

Figure 2: SEM and EDX analysis from experimental result for the non-affected region

References

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