

Mechanical Engineering Thesis Defense

Short-Term Reliability Evaluation of Glass-Glass Photovoltaic Modules: Influence of EVA and POE Encapsulants

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Abstract

The primary goal of this thesis is to evaluate the influence of ethyl vinyl acetate (EVA) and polyolefin elastomer (POE) encapsulant types on the glass-glass (GG) photovoltaic (PV) module reliability. The influence of these two encapsulant types on the reliability of GG modules was compared with baseline glass-polymer backsheet (GB) modules for a benchmarking purpose. Three sets of modules, with four modules in each set, were constructed with two substrates types i.e. glass-glass (GG) and glass- polymer backsheet (GB); and 2 encapsulants types i.e. ethyl vinyl acetate (EVA) and polyolefin elastomer (POE). Each module set was subjected to the following accelerated tests as specified in the International Electrotechnical Commission (IEC) standard and Qualification Plus protocol of NREL: Ultraviolet (UV) 250 kWh/m²; Thermal Cycling (TC) 200 cycles; Damp Heat (DH) 1250 hours. To identify the failure modes and reliability issues of the stressed modules, several module-level non-destructive characterizations were carried out and they include: colorimetry, UV-Vis-NIR spectral reflectance, ultraviolet fluorescence (UV-f) imaging, electroluminescence (EL) imaging and infrared (IR) imaging. The above-mentioned characterizations were performed on the front side of the modules both before the stress tests (i.e. pre-stress) and after the stress tests (i.e. post-stress). The UV250 extended stress results indicated slight changes in the reflectance on the non-cell area of EVA modules probably due to minor adhesion loss at the cell and module edges. From the DH1250 extended stress tests, significant changes, in both encapsulant types modules, were observed in reflectance and UV-f images indicating early stages of delamination. In the case of TC200 stress test, practically no changes were observed in all sets of modules. From the above short-term stress tests, it appears although not conclusive at this stage of the analysis, delamination seems to be the only failure mode that could possibly be affecting the module performance, as observed from UV and DH extended stress tests. All these stress tests need to be continued to identify the true failure modes and their impacts on the performance parameters of PV modules.



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Zoom Link: <https://asu.zoom.us/j/88645259142>