

Degradation in photovoltaic encapsulation strength of attachment: Results of the first PVQAT TG5 artificial weathering study

Abstract:

Delamination of the encapsulant in photovoltaic (PV) module technology results in immediate optical loss and may enable subsequent corrosion or mechanical damage. The effects of artificial weathering were not previously known; therefore, an empirical study was performed to survey the factors most affecting adhesion, including the ultraviolet (UV) source (ie, Xe or fluorescent lamp[s]), the optical filters for the lamp, the chamber temperature, and the relative humidity. Natural weathering was also performed at locations, including the following: Golden, Colorado; Miami, Florida; Phoenix, Arizona; Qionghai, China; Riyadh, Saudi Arabia; and Turpan, China. Specimens were constructed using a laminated glass/poly (ethylene-co-vinyl acetate)/glass geometry. The compressive shear test (CST) was used to quantify the mechanical strength of attachment, taken as a proxy for adhesion. The fractography of select specimens (including cross-sectional optical microscopy) was used to verify the failure mode (delamination or decohesion). Additional analysis of the local solar spectrum as well as the specimen temperature was performed to interpret the results of natural weathering. The goals of this study include to identify the most significant stressors, clarify where strong coupling may occur between stressors, and validate accelerated test results relative to natural weathering. The importance of specimen conditioning (for moisture) and hygrometric degradation as well as the effects of UV degradation are identified in this study.

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