EVALUATING TCO LONG-TERM PERFORMANCE BY ELECTROCHEMICAL CORROSION AND X-RAY DIFFRACTION RESIDUAL STRESS ANALYSIS

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Transparent conductive oxides (TCOs) are used as electrodes in thin film photovoltaic (PV) modules. Electrochemical corrosion test is a technique used for the evaluation of adhesion of TCO films to the glass substrates and assessing the long term performance of the films in PV modules. Delamination of TCO films during the test has been attributed to film residual stress, but no work of determining the residual stress has been reported. In this study, we applied the electrochemical corrosion test to three types of fluorine-doped tin oxide thin films deposited on glass to assess their susceptibility to delamination in thin-film PV modules. We also used X-ray diffraction (XRD) analysis to determine the film residual stress. One of the TCO films successfully passed the electrochemical corrosion test, while the other two failed, resulting in visible delamination and cracking. XRD analysis showed compressive residual stress in all the original TCO films. Residual stress values ranged from -723 MPa up to -1173 MPa. TCO films with higher values of residual stress showed delamination. It is proposed that the combined action of formation of sodium ions at the TCO/glass interface and water diffusion into the film during the electrochemical corrosion testing initiate straight-sided blister formation or buckling. When the compressive residual stress in the film is high, buckling-driven delamination occurs. This work illustrates that a good correlation between electrochemical corrosion testing results and residual stress analysis exists, and that both analyses can be used to ascertain TCOs long-term performance.

Abstract submitted for the 2012 Denver X-ray Conference.

Permission is granted to post abstract on website.

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Preference is for poster presentation in the XRD session.