**RESIDUAL STRESS ANALYSIS OF COPPER-INDIUM-GALLIUM-SELENIUM/MOLYBDENUM THIN FILM ON STAINLESS STEEL SUBSTRATE**

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Delamination is one of the critical issues for fabricating CIGS ($Cu(InGa)Se_2$)-based solar cells on a flexible stainless steel substrate. It is presumed that the delamination might be caused by the residual stress, coupled with defects and flaws at the CIGS/Mo interface. An analytical method was developed to measure thin film residual stress using x-ray diffraction method and validated by curvature measurements.

Since the delamination is always observed to occur between the CIGS/Mo interfaces, two sets of samples were analyzed to find the root cause: the first set of the samples only contains Mo/Nb back contact layer, this is used as a base line to compare the stress change after CIGS deposition; the second set of the samples has CIGS formed on the Mo layer, the residual stress of both CIGS and Mo layers were measured. The residual stress of Mo changed significantly after CIGS deposition. The as-deposited Mo had a tensile stress of approximately +400 MPa but changed to a large compressive stress (approximately -700 MPa) after CIGS deposition and subsequent oven heat treatment, presumably due to the difference in thermal coefficient of expansion between the Mo film and stainless steel substrate. The CIGS sample with good adhesion had almost stress-free CIGS layer, while the CIGS of poor adhesion samples showed a relatively large (-400 to -500 MPa) compressive stress. This large residual stress in the CIGS film coupled with defects and voids at the interface, is likely the source of the film delamination.