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A Simulation Tool for Leakage Currents and Ion Transport in Photovoltaic Modules JOHN WADDLE, MARCO NARDONE, Bowling Green State University — The reliability of solar electricity is becoming more challenging as utility-scale photovoltaic (PV) array voltages increase to 1500 V or more to reduce system cost. Modules that are at high voltages with respect to ground can experience power loss due to potential induced degradation (PID). Leakage currents that flow between the solar cells and module frame via the dielectric packaging materials are predicators of electrochemical corrosion and other deleterious PID effects, including delamination and shunting. The shunting effect (often referred to as PID-s) has been associated with sodium ion migration and contamination of structural faults across the p-n junctions of the solar cells. In this work we report on the development of a simulation tool for leakage currents and ion transport in PV modules. By consolidating the relevant physical models of charge transport through the bulk dielectric packaging materials and along interfaces, leakage current and sodium ion distribution are calculated as functions of voltage, temperature, and relative humidity. Results are compared to data from the literature. With 3D and time-dependent capabilities, this simulation tool allows for the prediction of leakage current in outdoor environmental conditions and in damp heat stress tests.

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