

Detection and acceleration of potential induced degradation on silicon photovoltaic modules

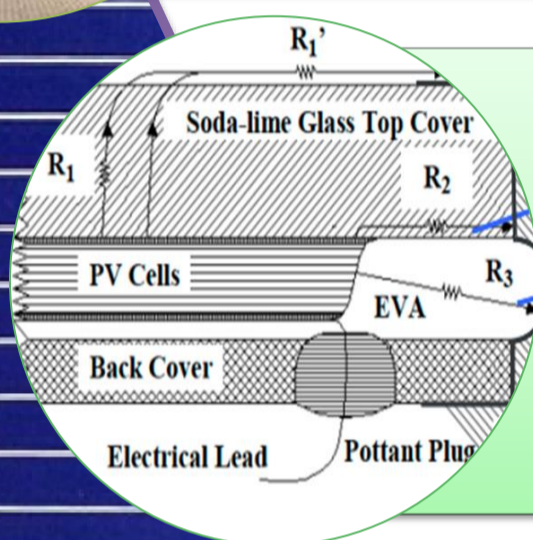
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Master IW energie



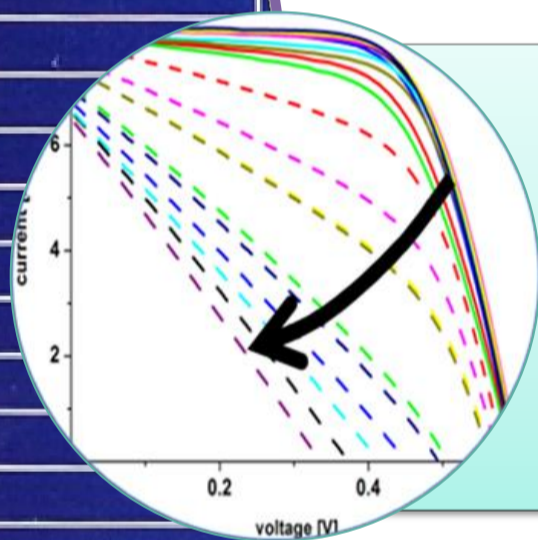
Institute for Materials Research (IMO)

- Research group Energy System Engineering (ESE), led by Prof. dr. ir. Michaël Daenen, is established in the institute for material research
- ESE investigates the reliability of photovoltaic (PV) modules.
- The main objective of this master's thesis is the realization of a setup to accelerate and detect Potential Induced Degradation (PID) in silicon PV-modules.



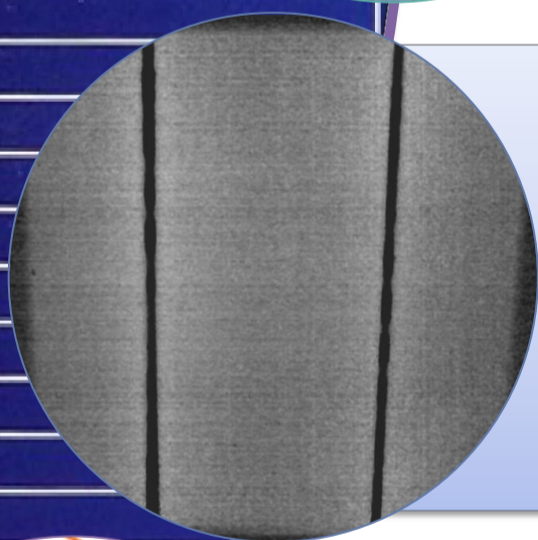
Potential Induced Degradation (PID)

- High voltage on system level, caused by a large number of PV modules in series
- High potential difference between PV cell and module frame
- Leakage current of Sodium (Na) ions
- Loss of power due to local shunting



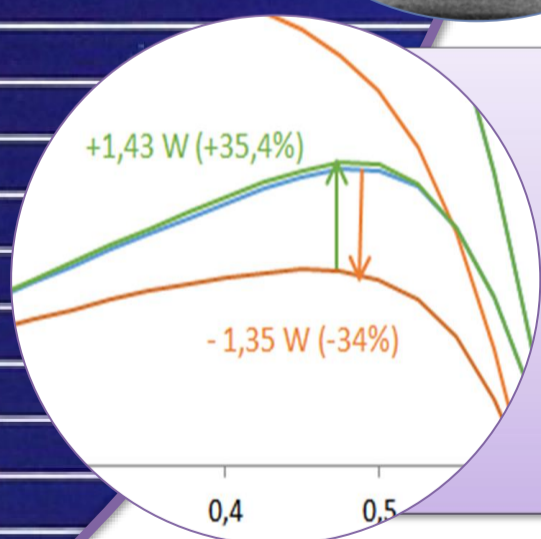
IV curve

- Current and power plotted in function of the voltage
- Isc is the current that flows from the PV module when the module is short circuited
- Voc is the voltage at the PV module connectors when no load is applied
- Pmax is the maximum power a PV module can generated
- PID will lower the local shunt resistance, thus lowering the angle of the graph at Isc



EL-imaging

- When applying a current through the PN-junction, electrons will dissipate energy into light
- The light has a wavelength of 1150 nm, because the semiconductor is silicon therefore the light emitted is in the near infra red area and not visible to the human eye
- Silicon charge-coupled device (CCD) sensor is capable of detecting the near IR light, a CCD sensor converts electromagnetic radiation into a electrical charge
- Therefore, a webcam has been modified to increase the sensitivity in the near IR area and decrease the sensitivity in the visible light area.



Conclusion

- PID testing and curing is possible
- Functioning shutter for solar simulator
- Developed a setup for measuring IV-curves of PV modules
- Designed a setup for measuring an IV curve of a PV cell vertically

Promotoren / Copromotoren: Prof. dr. ir. Daenen Michaël
ing. Carolus Jorne

References: imomec; P. Hacke, "Considerations for a Standardized Test for Potential-Induced Degradation of Crystalline Silicon PV Modules."; M. B. Koentopp, C. Taubitz, M. Schütze, Kröber, and Marcel, "A PID model ensuring 25 years of service life nrel,". A. Ndiaye, A. Charki, A. Kobi, C. M. F. Kébé, P. a. Ndiaye, and V. Sambou, "Degradations of silicon photovoltaic modules: A literature review," Sol. Energy R. Arndt and R. Puto, "Basic understanding of IEC standard testing for photovoltaic panels," V. Naumann, D. Lausch, A. Graff, M. Werner, S. Swatek, J. Bauer, A. Hähnel, O. Breitenstein, S. Großer, J. Bagdahn, and C. Hagendorf, "The role of stacking faults for the formation of shunts during potential-induced degradation of crystalline Si solar cells,"