

Microcracks detection in triple-junction solar cells

Feasibility study

Graduate



Josef Vondrák

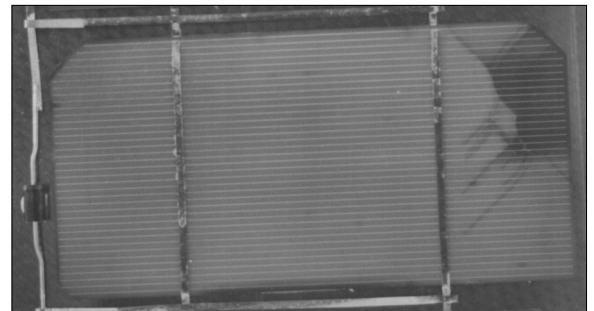
Problem: The measurement & evaluation of the health of the triple junction solar cells for space application is a critical step in keeping the required performance and function of spacecrafts. The usual method to measure the cell's health is by electroluminescence, as it is quick, doable with plain visual inspection or with commercially available cameras and does require only a power source as additional component. However, another method - photoluminescence requires even less. In theory, only a light source strong enough to excite the electrons to cross the band gap is needed. The method developed and tested in this thesis is based on detectable difference in imaging of the open and short circuit configuration of strings of solar cells under normal working-room light conditions.

Objective: The goal of this thesis is to provide RUAG Space with an alternative measuring method (to electroluminescence) for checking the health of the solar cells for space application. This thesis should deliver the necessary characterization of all needed equipment and a confirmation that this method is functional and applicable. The specified equipment shall be usable for both electro- and photoluminescence measurements and be in compliance with the specified requirements.

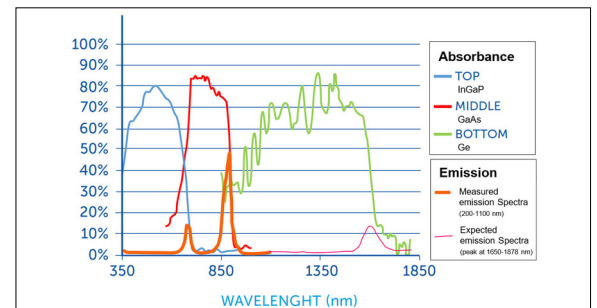
Approach: To verify the functionality of the measurement method, a breadboard of solar panels was created reflecting the design and constraints of space-grade solar panels. The testing of the basic idea of photoluminescence was performed with the testing equipment borrowed from OST which has been adapted to the needs of the project and the facilities of RUAG Space. The adaptation was to hardware – instead of the pyramid

shape cone being placed on the cells and shading any incoming light, a non-shading light frame was developed. The software part of the testing process was amended by a postprocessing of the acquired images in order to highlight the defects.

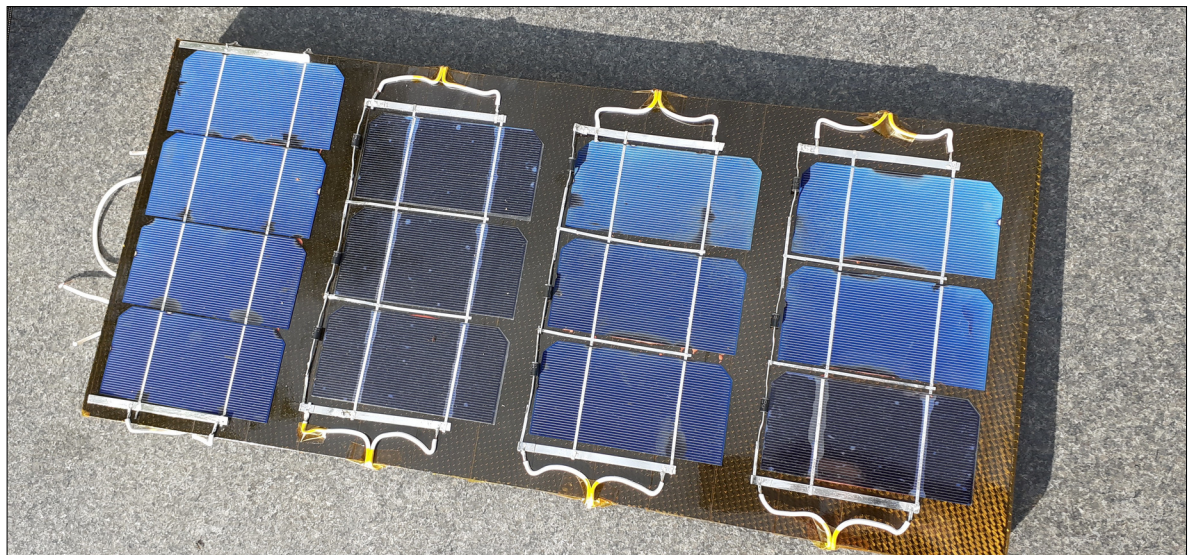
A photoluminescence measurement of a defected cell.
Own presentment



Absorbance/Emission spectra of a 3J solar cells for space.
<https://www.cesi.it/app/uploads/2020/03/Datasheet-CTJ-LC.pdf>



Breadboard created to verify the functionality of the measurement technique.
Own presentment



Examiner
Prof. Dr. Benno Bucher

Co-Advisor
Philipp Schmidheiny,
RUAG Schweiz AG,
Zürich, ZH

Subject Area
Electric solar
technology

Project Partner
RUAG Space AG,
Zürich, ZH