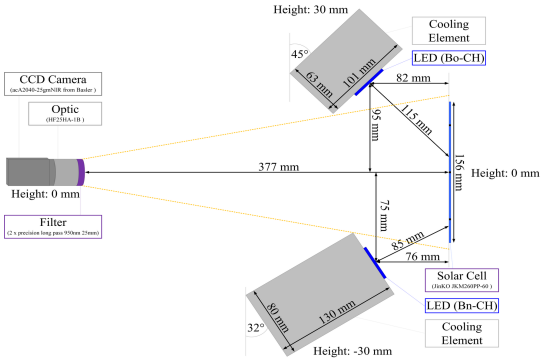
Martin
Koch

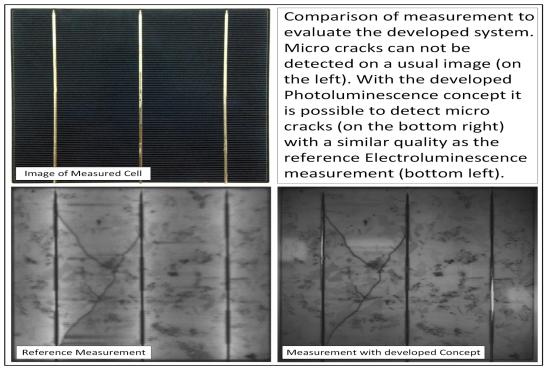
Students	Martin Koch
Lecturers	Prof. Dr. Benno Bucher
Advisors	Dr. Jürg Neuenschwander , EMPA , Dübendorf , ZH
Topic	Environmental Engineering

Mobile Photoluminescence Measurement of Silicon Solar Cells for Micro Crack Detection

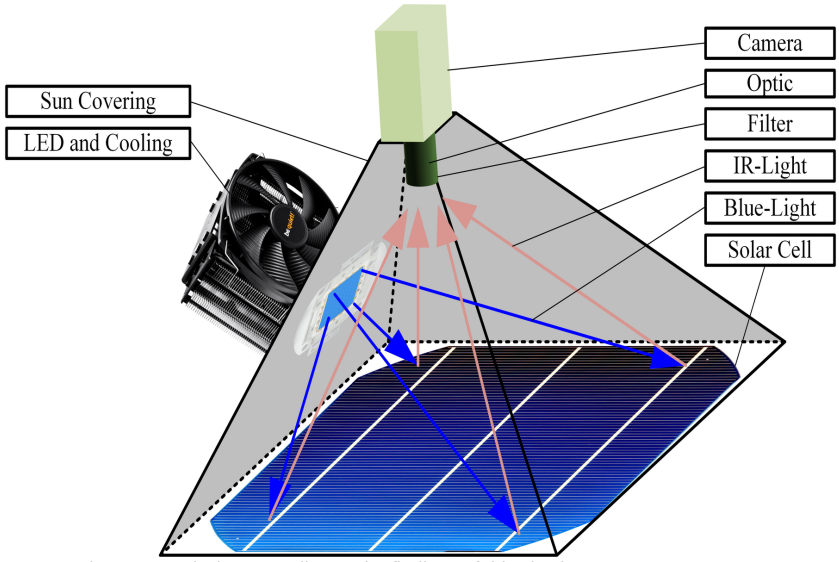
Feasibility study



Schematical representation of developed measurement concept.



Comparison of measured cells with respect to reference measurements.



Suggested prototype design according to the findings of this Thesis.

Introduction: Development of a measurement concept to detect micro cracks of an installed Silicon solar plant, as they are invisible to the human eye. Following the principle "never change a running system", the main focus of this concept lays on a solution able to detect micro cracks without dismounting or even touching the installed panels. Therefore, particular attention should be paid on a light and compact design which can be mounted on a drone. The drone itself is not part of this thesis. With the elaborated concept on the left, first measurements are carried out. The measurement concept is based on Photoluminescence. Two high power blue LEDs excite the Silicon Panels in order to trigger illumination in the spectrum between 950 to 1350 nm. The reflected blue light is filtered, hence, just the long wave luminance from the cell is captured by the camera. While good Silicon parts illuminate, cracks stay dark.

Proceeding: To verify the developped concept, its results are compared with reference measurements. SPF made this reference measurements with electroluminescence of the MBJ Mobile Solar Test Labour. As micro cracks can not be detected on a usual image (2nd image on the top left). With the developed Photoluminescence concept it is possible to detect micro cracks (2nd image on the bottom right) with a similar quality as the reference Electroluminescence measurement (2nd image bottom left).

Result: This thesis shows that photoluminescence measurement can detect micro cracks with the described equipment. According to the findings of this thesis, the following design (3rd image) is suggested, respecting several difficulties like sun shielding and low light intensity.