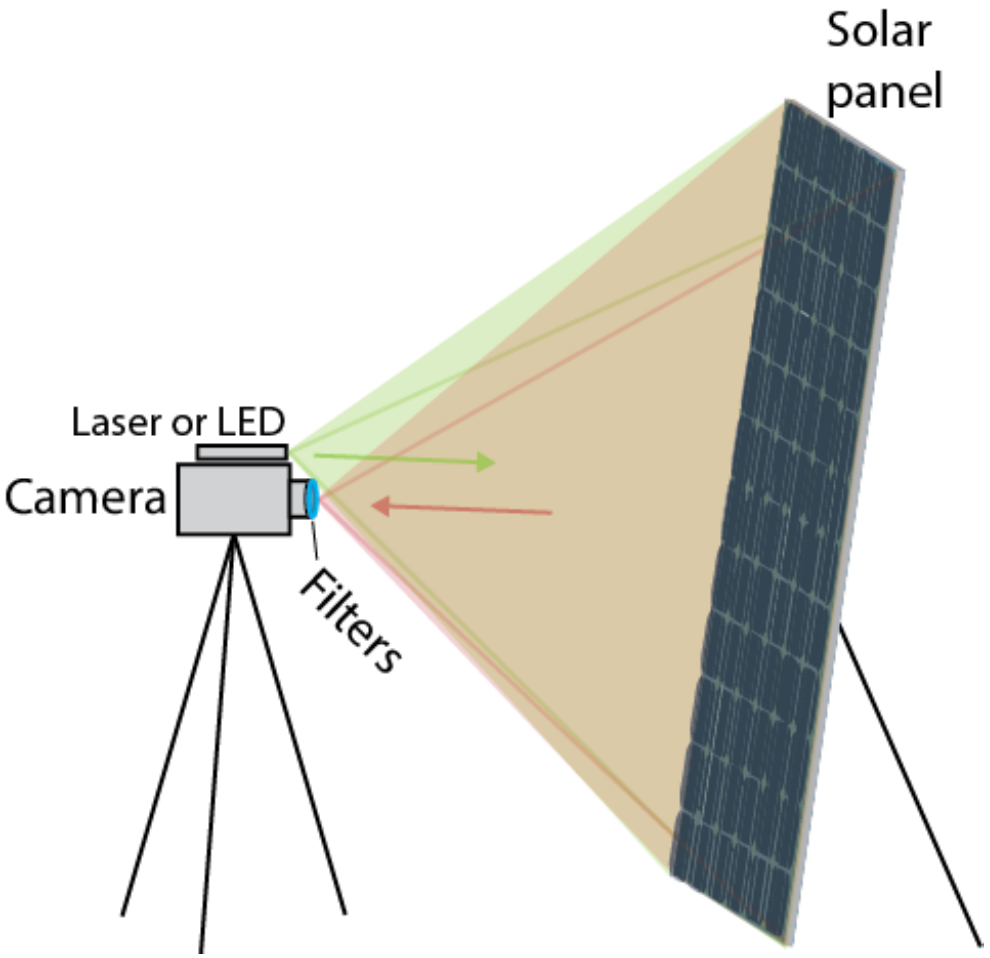
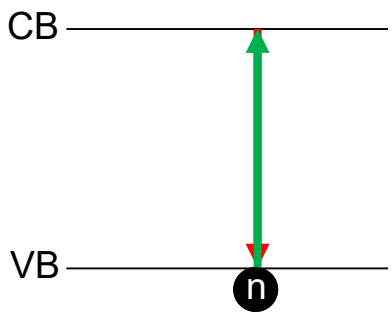
Block 4 – Imaging
Part 3: Photoluminescence Imaging

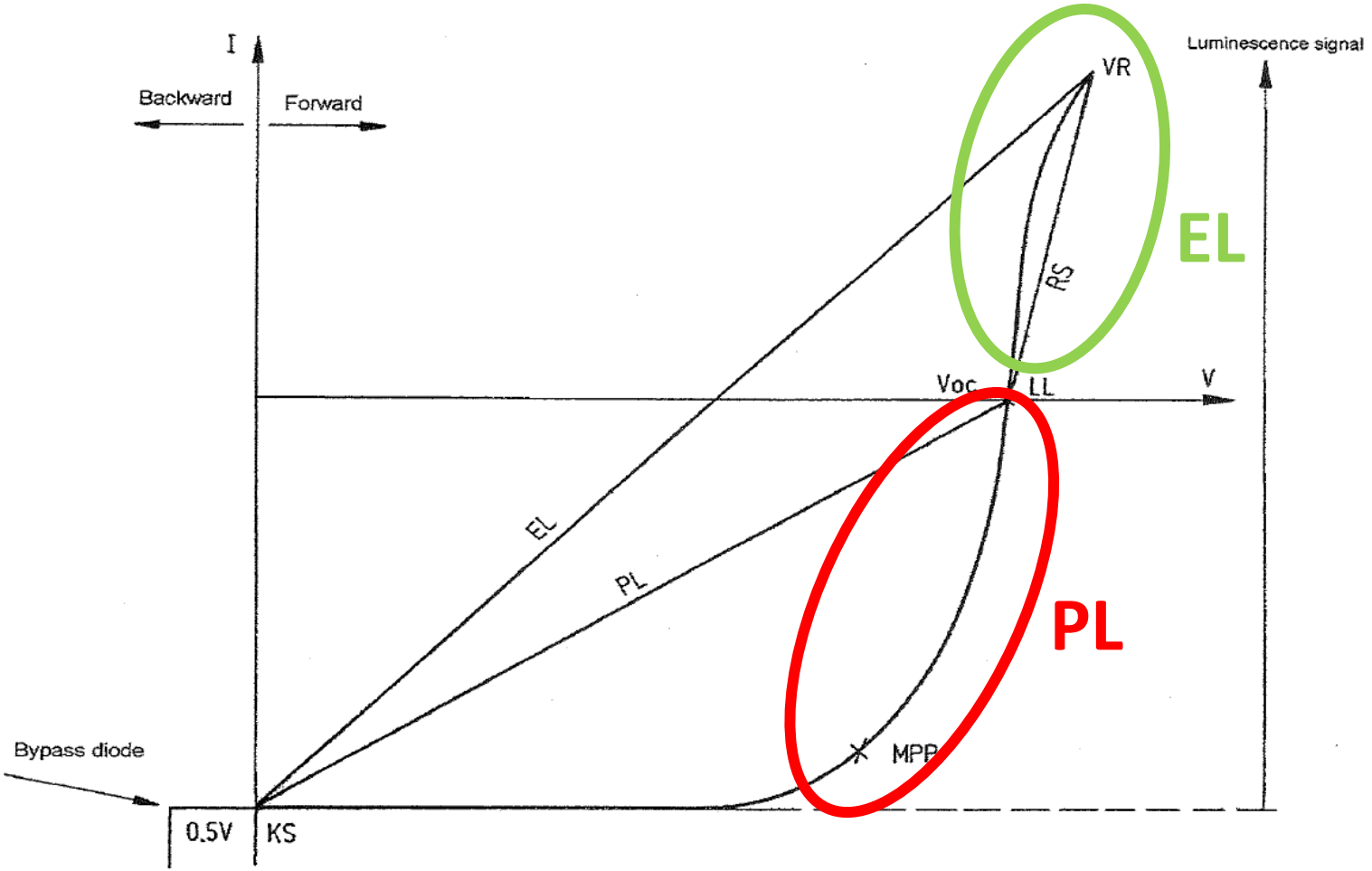
34553: Applied Photovoltaics

Photoluminescence (PL) Imaging



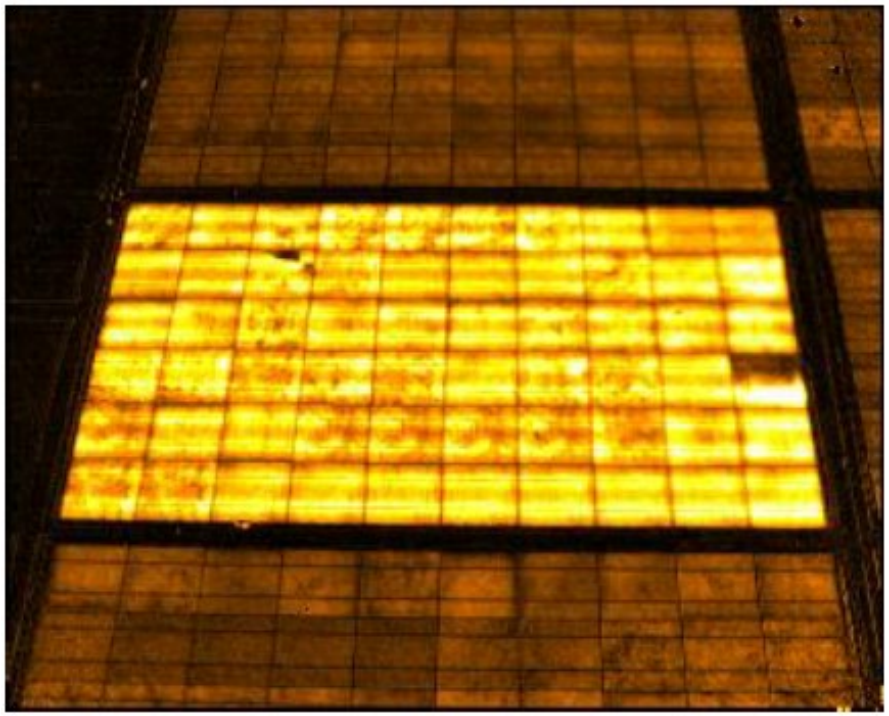


Photoluminescence (PL)

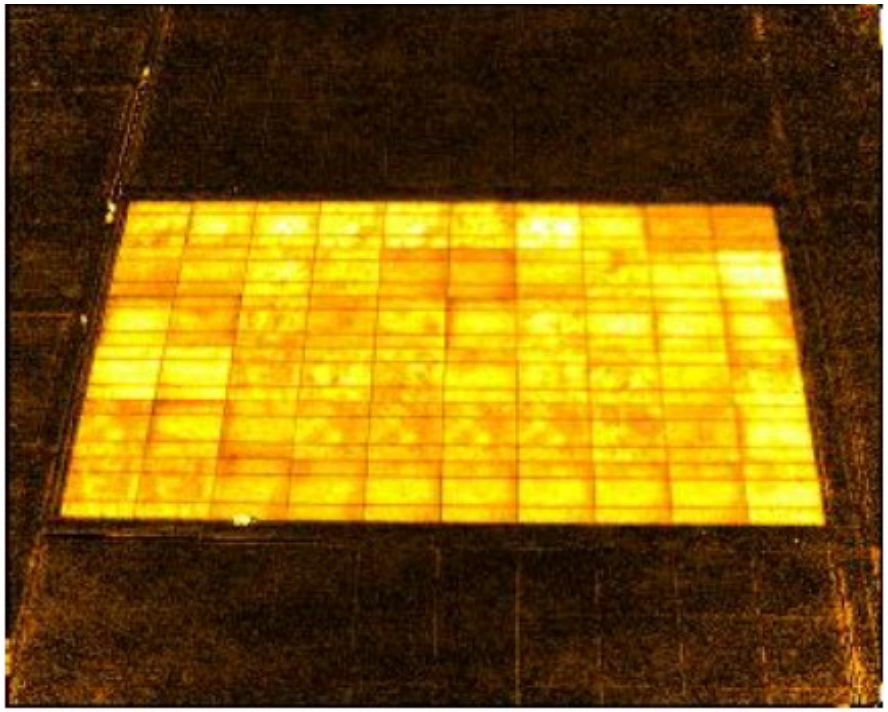


Outdoors PL

- Using the Sun as light source



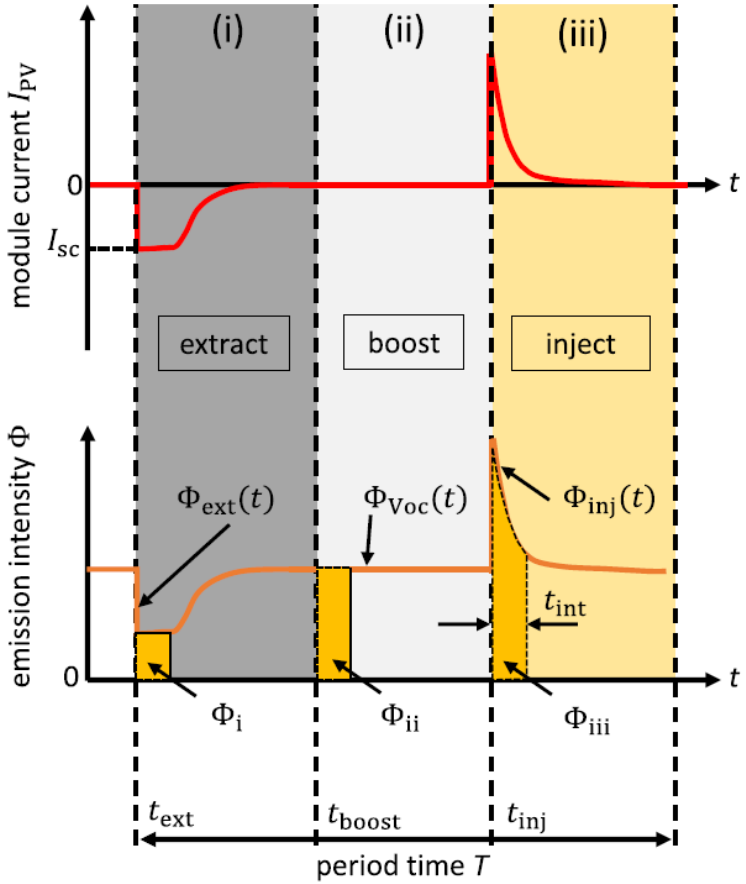
a) Electroluminescence

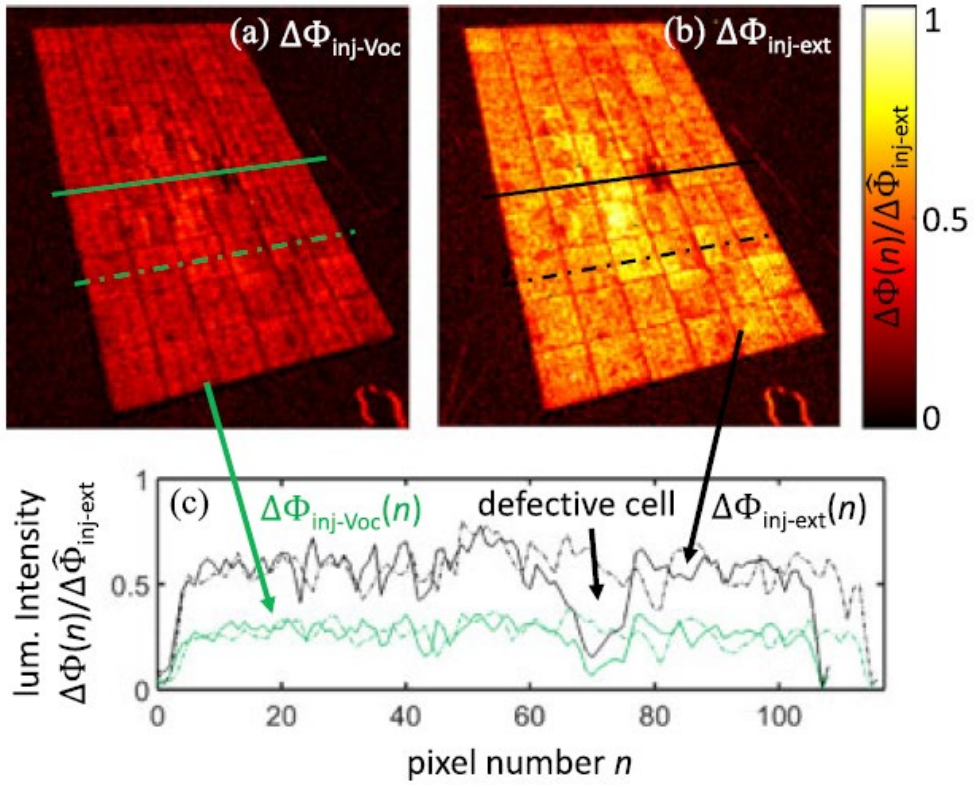


b) Photolumiescencce

29th Eur. Photovolt. Sol. Energy Conf. Exhib., pp. 2553–2554, 2014.

Daylight PL+EL

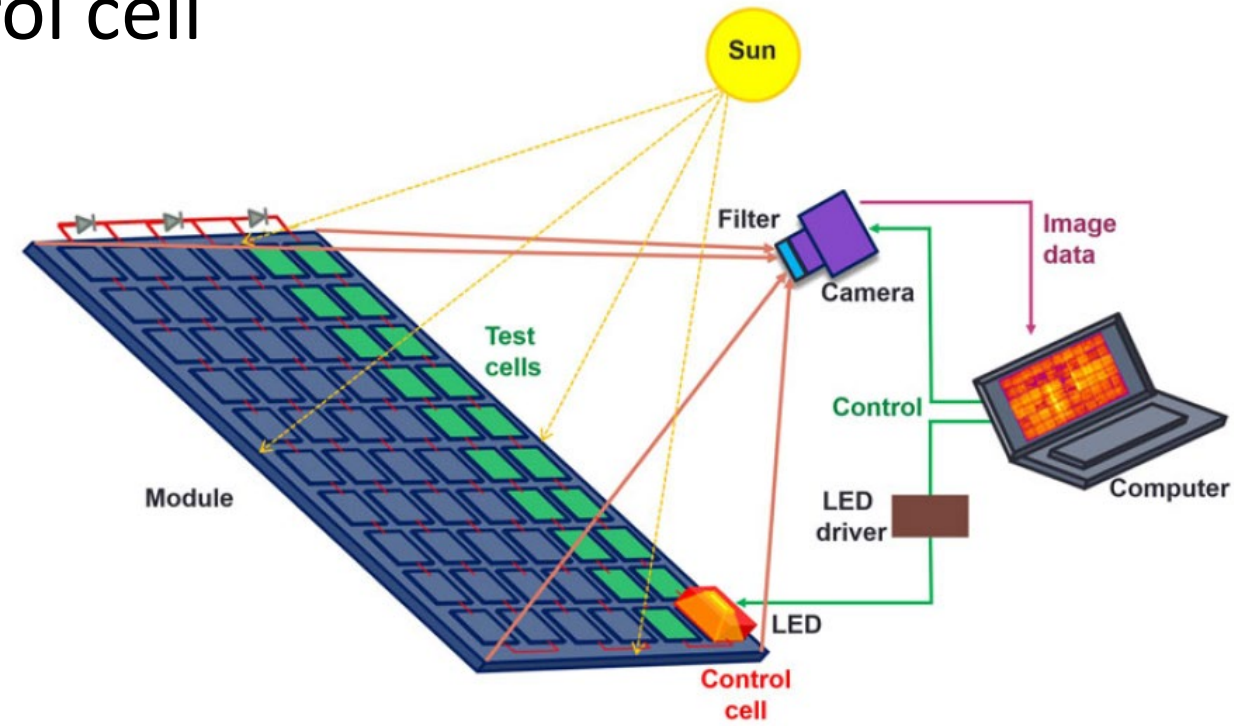




IEEE J. Photovoltaics, vol. 7, no. 5, pp. 1184–1189, 2017.

Daylight PL

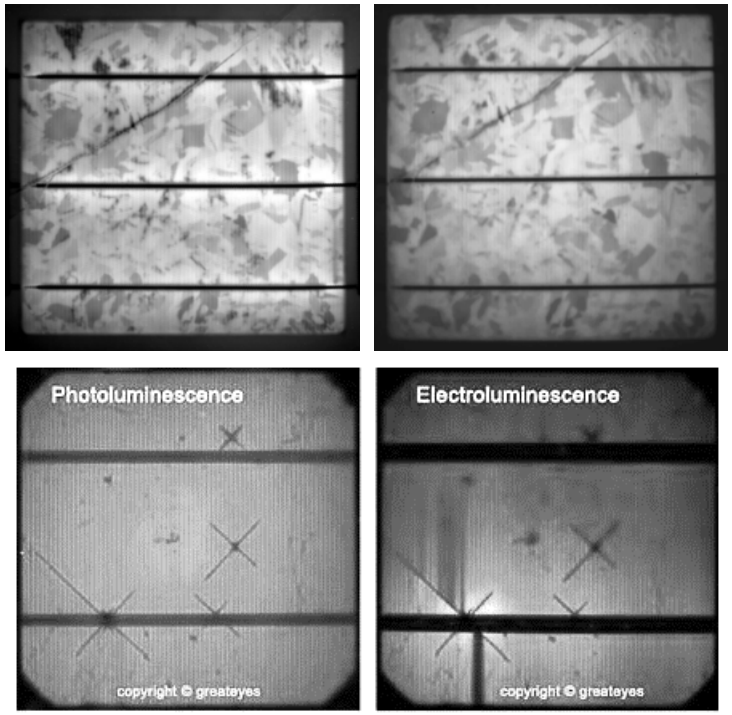
- Using the Sun as light source
- Modulation through a light source over a control cell



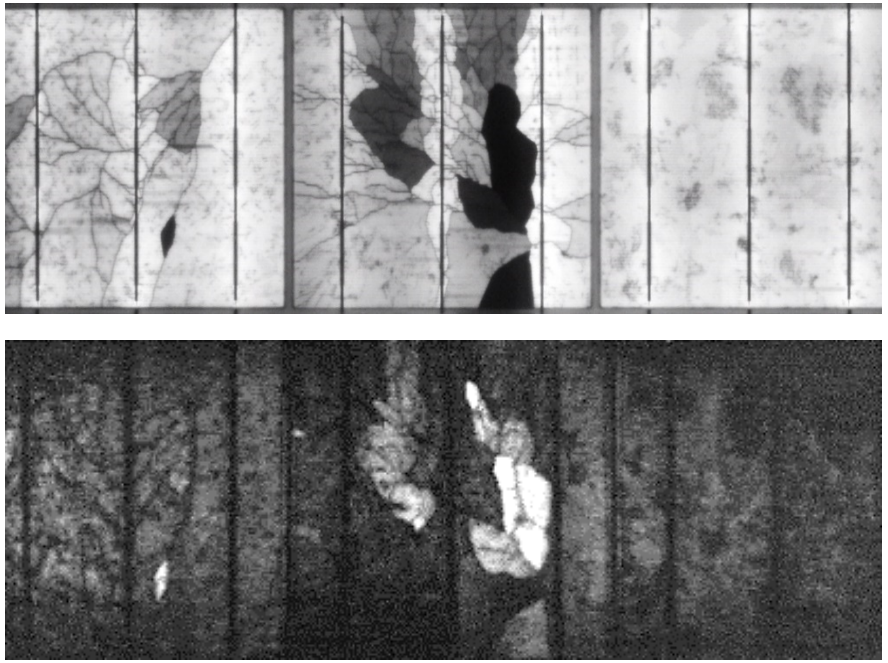
R. Bhoopathy, O. Kunz, M. Juhl, T. Trupke, and Z. Hameiri, *Prog. Photovoltaics Res. Appl.*, no. July, pp. 14–16, 2017.

EL and PL Comparison

EL **PL**



EL

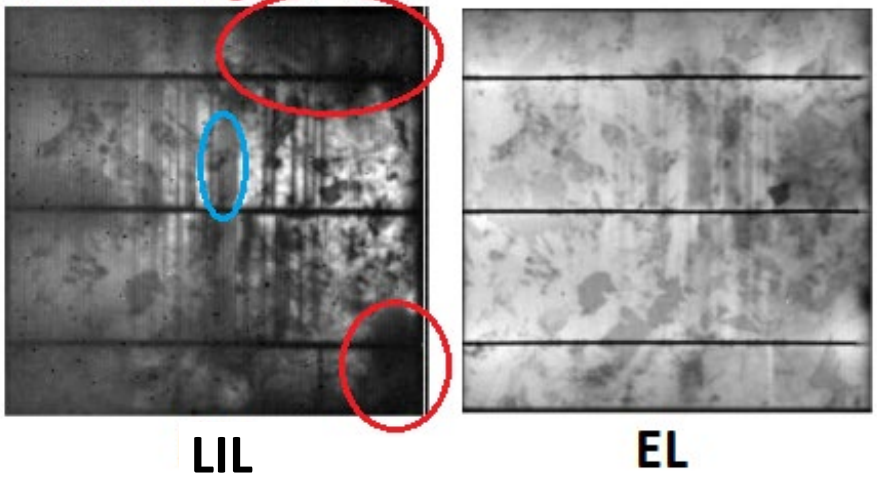


LIL

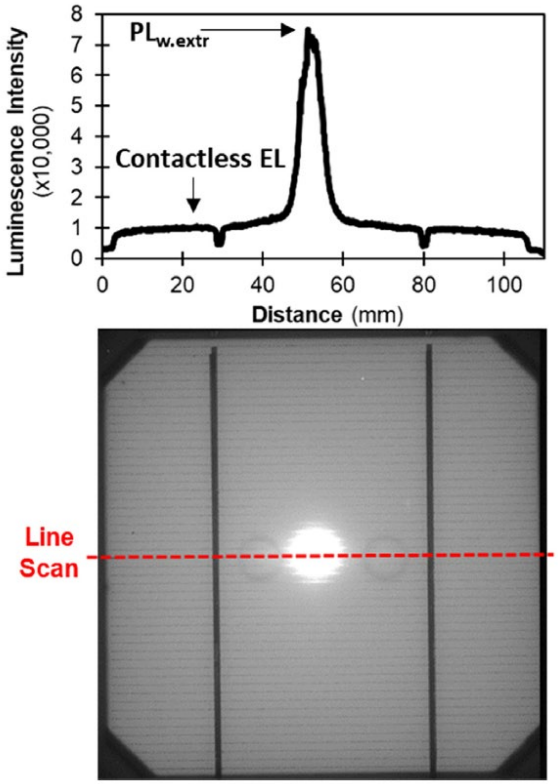
Laser Induced Luminescence (LIL)

Unhealthy PV areas not shown in the EL image

Finger interconnection defects that are shown in EL. They don't appear in traditional PLI, but are clearly visible in laser line PLI.



LIL EL

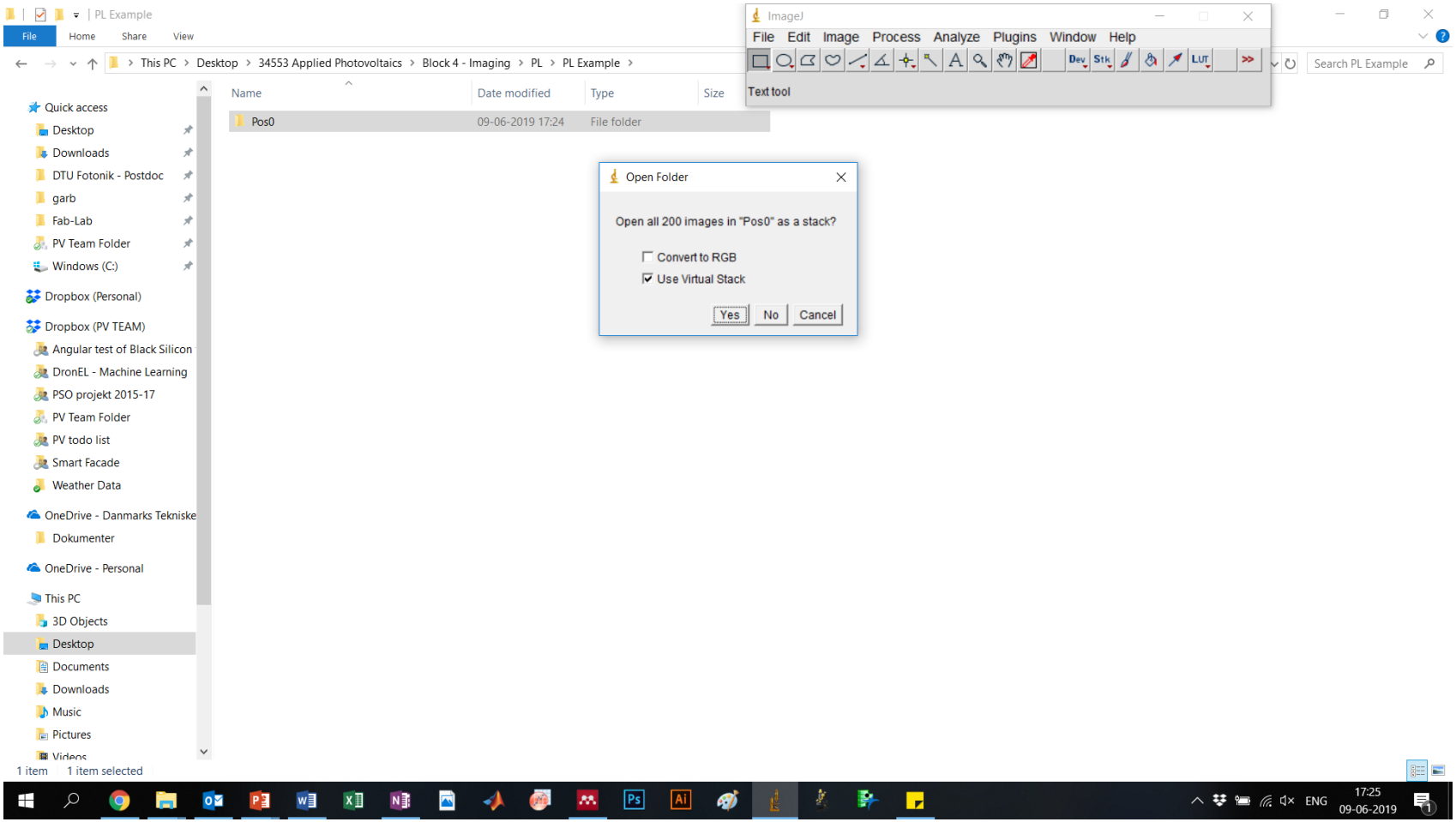


Solar Energy Materials and Solar Cells 192 (2019) 81–87

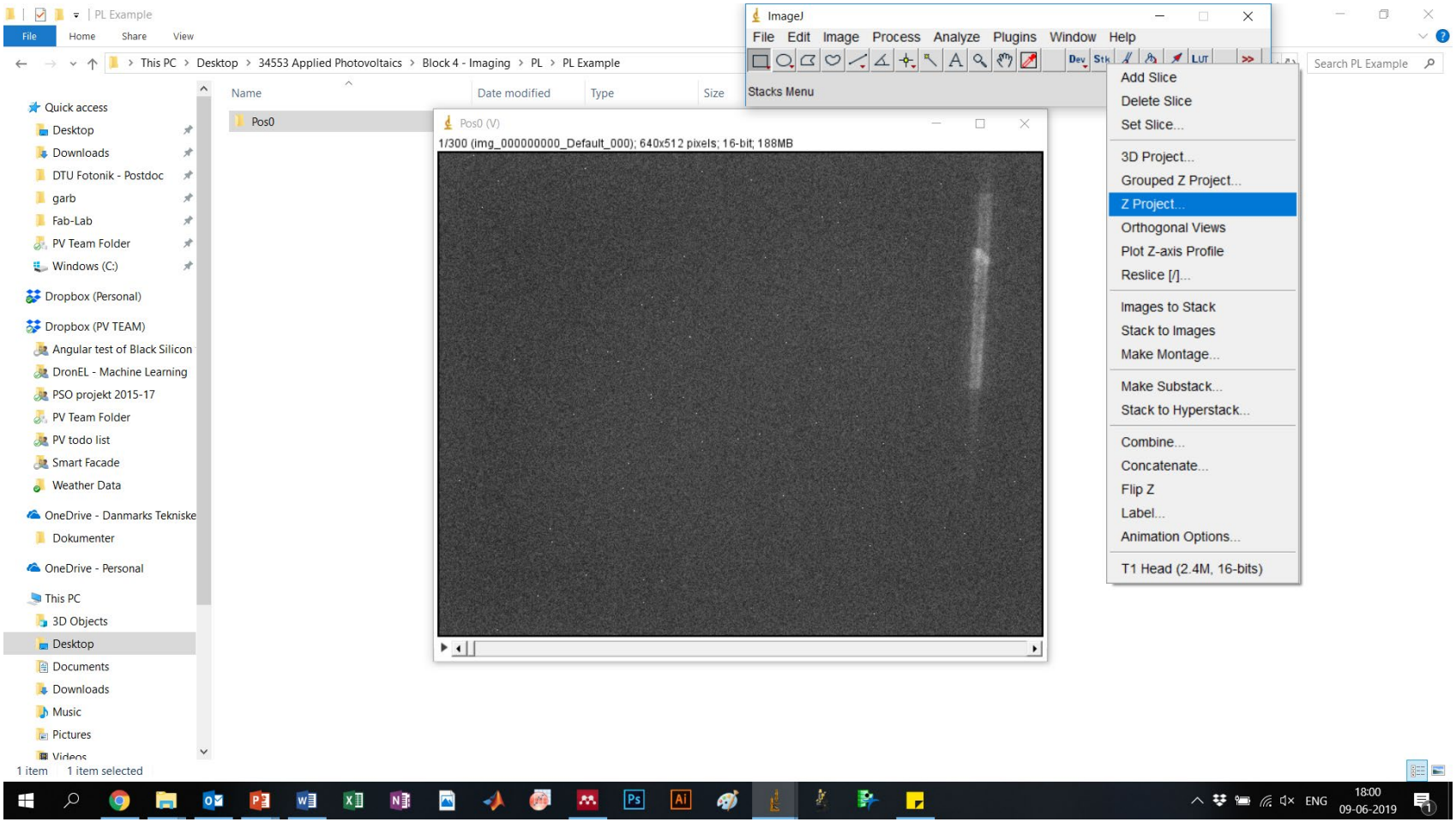
Image Processing - ImageJ

- Simple method to construct the PL image
  - Import the image sequence into ImageJ
  - Build the standard deviation image of the image sequence (stack)
    - Only of the frames of interest to avoid saturation when the laser was not moving
  - Crop, convert to 8bits and enhance the contrast if needed

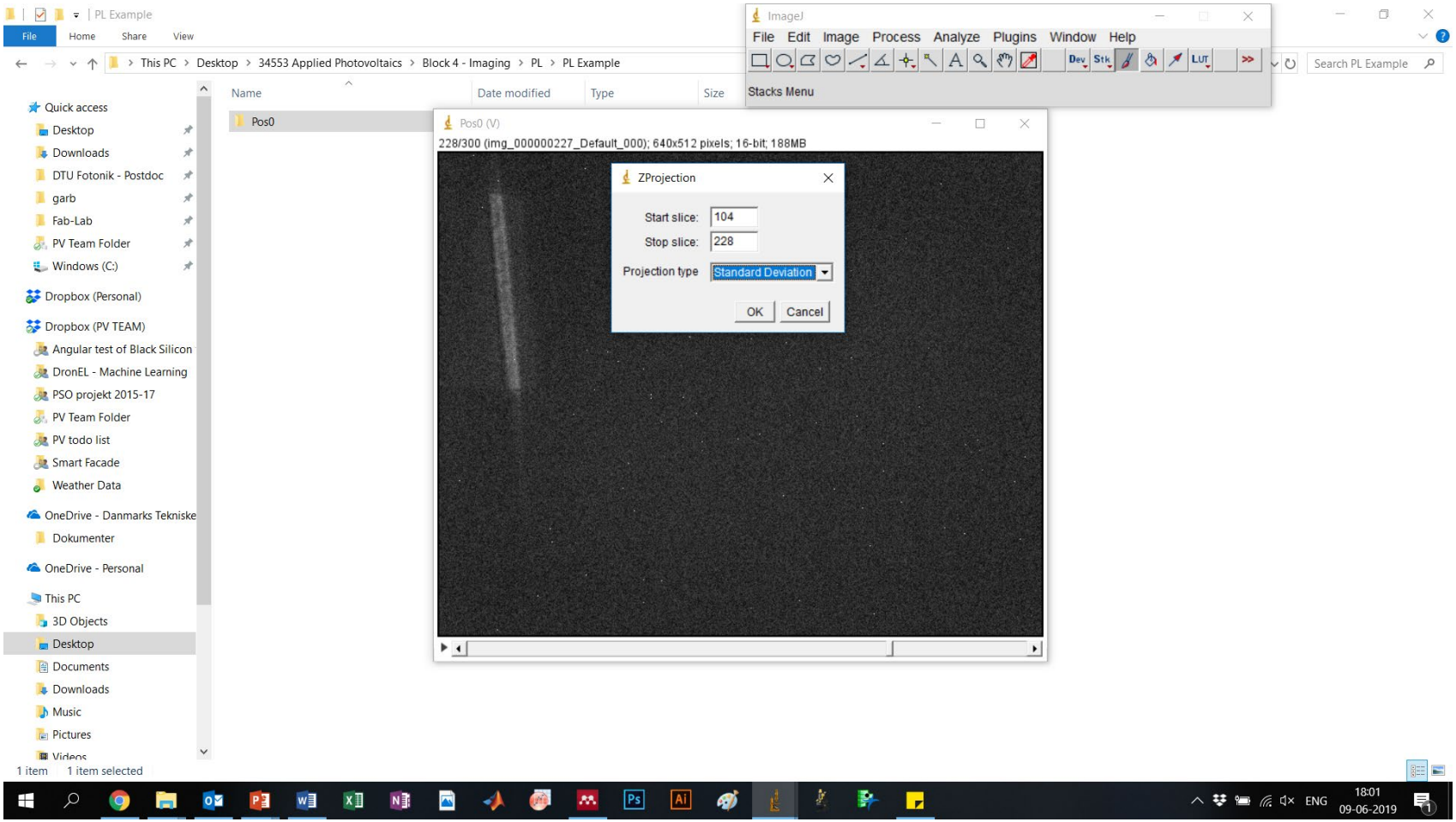
Drag and drop image sequence folder



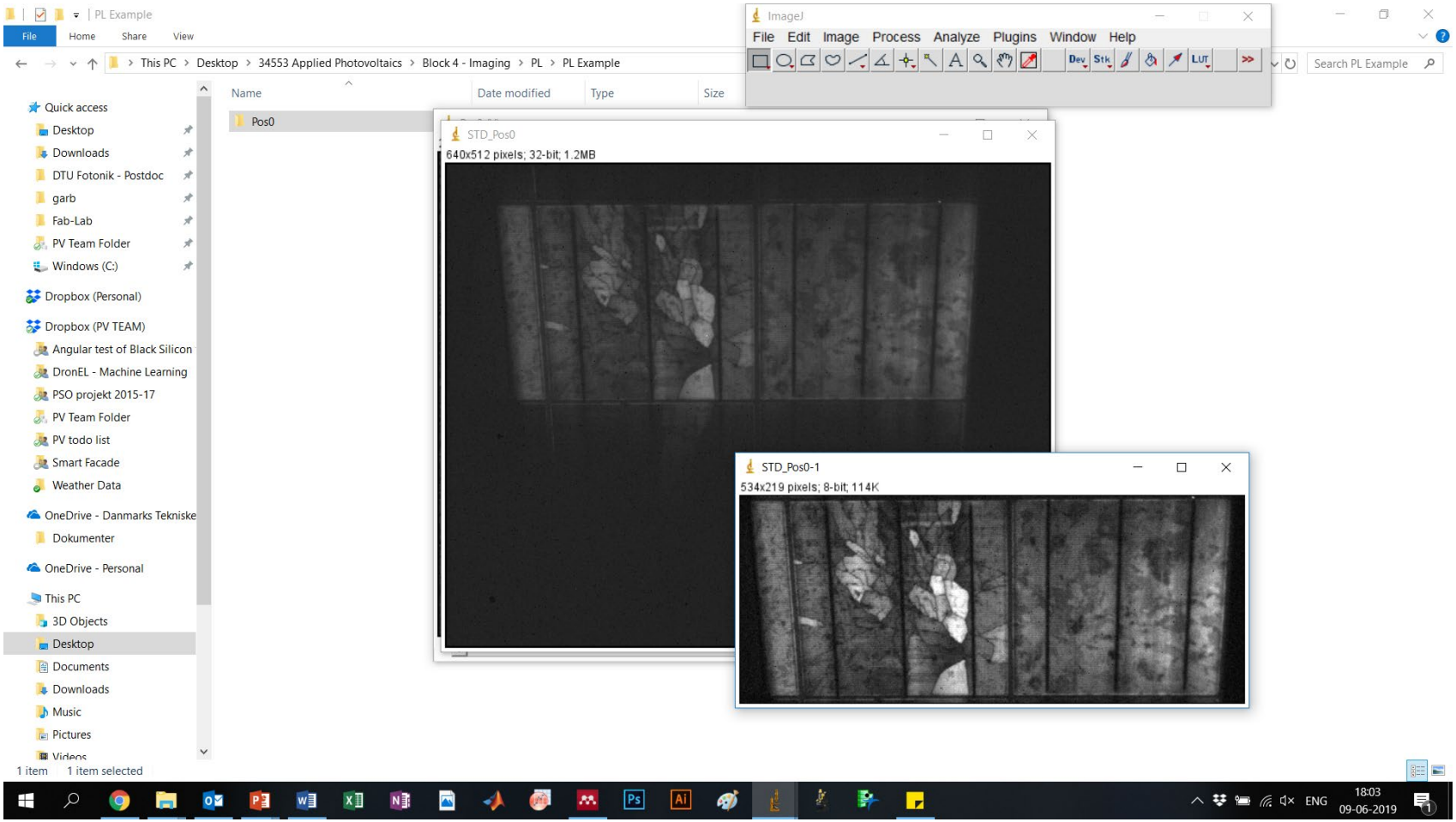
Take a Standard deviation image of the image sequence (stack)



Take a Standard deviation image of the image sequence (stack)



Crop, convert to 8bits and enhance the contrast if needed



Your Working Module EL

- Evaluate the most interesting region of your PV module to PL:

After the EL lab exercise, insert an 100% Isc EL image from the group working module here