Technology Offer

Lock-in thermography evaluation software for solar cells
Local I-V 2 (replacing Local I-V)

Ref.-No.: 1401-4359-WT

The efficiency of solar cells is strongly affected by local inhomogeneities. Especially inhomogeneities of the dark-current voltage (I-V) characteristic are of interest: The local dark current-voltage characteristic is a measure for the local recombination properties of the solar cell. Lock-in thermography performed in the dark (DLIT) can be used to detect and evaluate locally increased dark current densities.

Background

Usually, the global and local characteristics of a solar cell can be described by the two-diode model. Three contributions to the dark current are considered in this model: The “diffusion current”, the “recombination current” (plus an ideality factor), and an ohmic “shunt current”, all as function of the local voltage. These current contributions are described by the local two-diode parameters. DLIT images can be evaluated and locally fitted to the two-diode model [1]. However, until now it was not possible to calculate with this method realistic values for, *inter alia*, the local efficiency, open circuit voltage, or fill factor [2].

Technology

The software Local I-V 2 is described in its operation manual. The scientific background can be found in the articles [1,2]. The software analyzes dark lock-in thermography measurements and converts them into a 2-D model of the cell (Figs. 1 and 2). For the analysis of a solar cell, up to four DLIT images taken at different biases are used to determine the local two-diode parameters mentioned above [2]. In contrast to its legacy application Local I-V [1], which calculated only dark characteristics of the local diodes neglecting the local series resistance, Local I-V 2 can calculate dark and illuminated I-V characteristics, now correctly taking into account the influence of the local series resistance [2]. This allows for a detailed local efficiency analysis of the investigated solar cells. Especially, the influence of certain defects on the various efficiency parameters of the solar cell can be determined.

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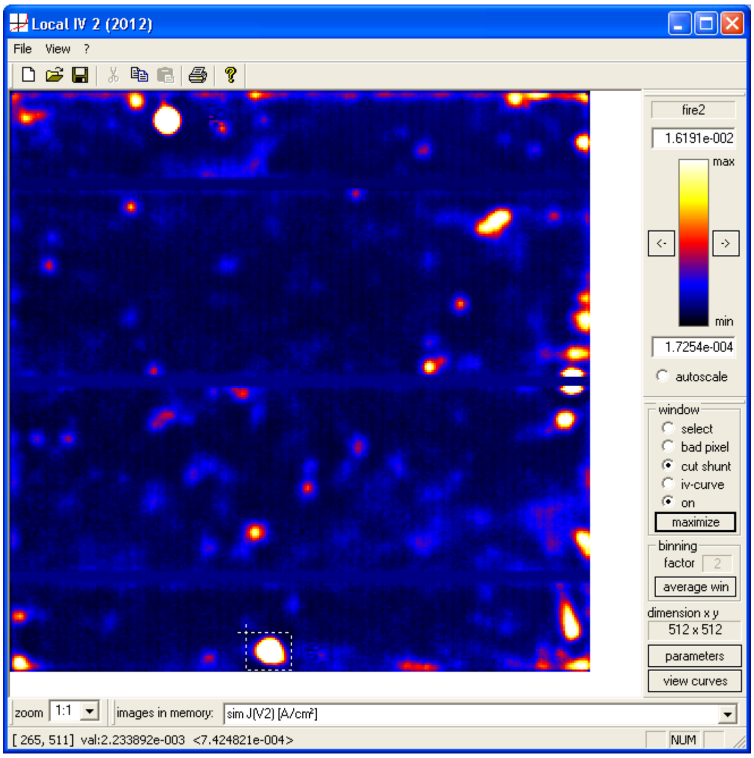

Fig. 1: Screenshot of the main window of *Local I-V 2* with a simulated current density image displayed.

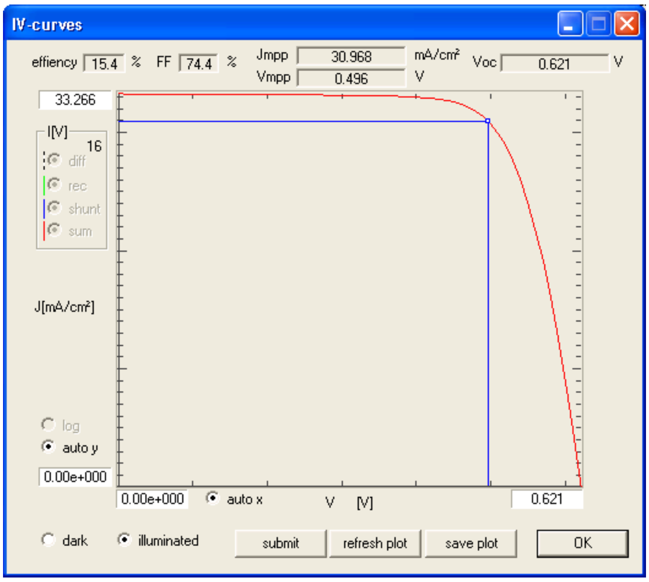

Fig. 2: Screenshot showing the simulated *I-V* curve for a position or region selected in the main window as calculated by *Local I-V 2*.

Literature

[1] O. Breitenstein, *Nondestructive local analysis of current-voltage characteristics of solar cells by lock-in thermography*, Solar Energy Materials & Solar Cells **95** (2011) 2933-2936

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[2] O. Breitenstein, *Local efficiency analysis of solar cells based on lock-in thermography*, Solar Energy Materials & Solar Cells **107** (2012) 381-389

[3] O. Breitenstein, F. Frühauf, M.Turek, *Improved empirical method for calculating short circuit current density images of silicon solar cells from saturation current density images and vice versa*, Solar Energy Materials & Solar Cells **154** (2016) 99-103

Cost

Single-user license for the software *Local I-V 2*: **EUR 800.00**

Software and manual (available in PDF and PostScript format) are sent to you via email or mail (as CD-ROM).

Keywords

Lock-in thermography, solar cells, *I-V* characteristics, DLIT, local efficiency analysis

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