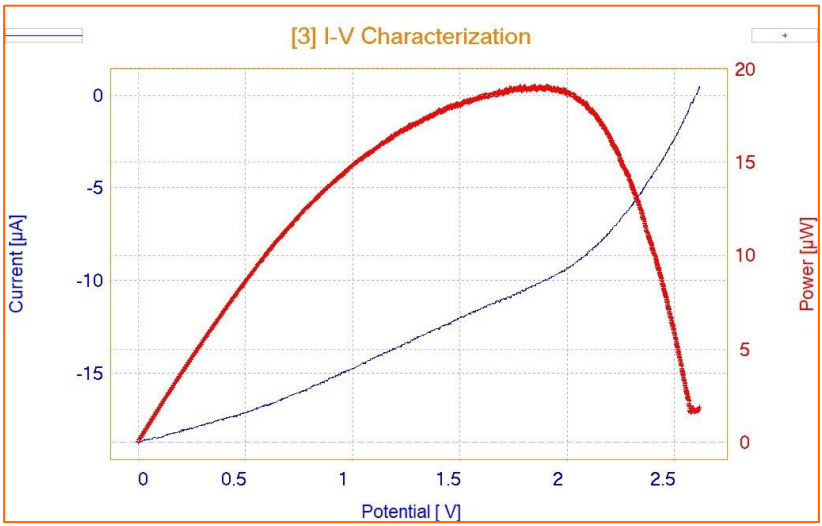
Application Note

Battery
AP-B06

I-V characterization of solar cell



In this application note electrochemical behavior of an industrial solar cell was investigated by I-V characterization method under different LED light sources.

The user will be understanding how to extract data from the I-V curve regarding solar cell specifications.

INTRODUCTION

A photovoltaic or solar cell, is an electrical device based on semiconductors, that converts the energy of light directly into electricity.

As in this process no fuel is using, this is a clean energy that could be replaced with other electricity generators in future for environment protection and reduce greenhouse effect.

About the Light Source

LED revolver used in this application note is a light source that contains 9 high power LEDs placed on a revolving stand. Only one of the LEDs can be turned on at the time.

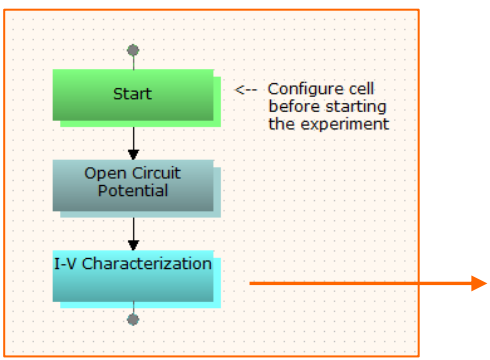
LED selection, light intensity, duration of emitting light and other parameters are driven from the related program on PC (figure 1).

Figure 1: LED revolver

The device could be ordered with a cage type of sample holder with a manually adjustable lens that is used to focus light on a sample or on a wavelength.

PARAMETERS

This experiment was performed by OrigaMaster software. I-V characterization method is found in sequence ribbon of software. The parameters of the test is shown in figure 2.



I-V Characterization	
Potential 1 (mV)	0, FREE
Potential 2 (mV)	0, REF
Scan rate (mV/sec.)	20, 0.02, 0.45
Sampling rate 1 point out of...	1
Maximum current (mA)	500
Minimum current (mA)	-500
Ohmic Drop Comp.	No
Maximum range	Auto
Minimum range	Auto
Open circuit at end	Yes
Save points	Yes
Analog Filter	Auto
Digital Filter	3

Figure 2: Parameters of I-V method for photovoltaic cell

Potential were swept from 0 mV vs OCP to 0 mV vs Reference electrode.

With the above default settings the I-V curves of solar cell were obtained on these wave lengths: 372, 390, 400, 424, 449, 528, 590, 624 and 2740 nm.

The measured properties were changed by changing the wavelength.

TIPS: In order to have stable cell set up, before run the main test, always OCP is measured.

RESULTS AND DISCUSSIONS

Figure 3 shows curves gained by I-V characterization method on solar cell in front of LED 372 nm of wavelength. Thanks to "Photovoltaic Analysis" which is find in "curve" ribbon, data will be extracted from I-V curve.

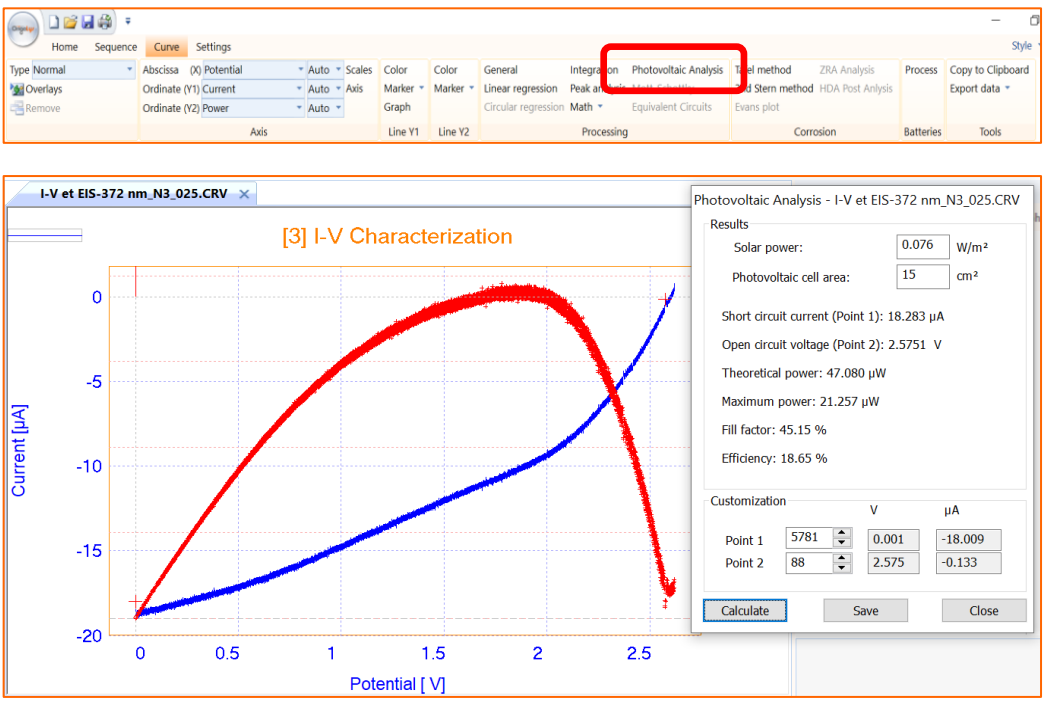


Figure 3: I-V curve of solar cell gained in front of LED 372 nm; related data is extracted from "Photovoltaic Analysis" window.

TIPS: Two important factors which needs to be entered in the boxes are « **solar power** » which is mentioned in the specification of light source, and « **Photovoltaic cell area** » correspond to active surface of solar cell in front of light source.

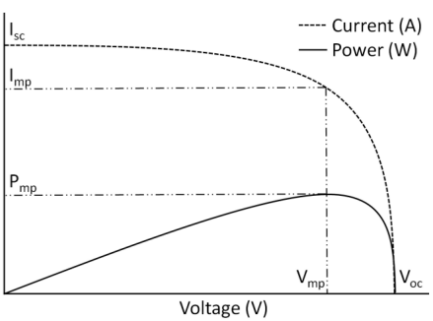
RESULTS AND DISCUSSIONS

From data extracted by "photovoltaic analysis" window (figure 4), it could be understood that in 372 nm, the "Short circuit current" – where the potential is 0 – is 18.28 µA, "Open circuit voltage" is 2.57 V, "Theoretical power" is 47.08 µW, "Maximum power" is 21.26 µW, "Fill factor" is 45.15% and "Efficiency" is 18.65%.

TP (Theoretical power) = Short circuit current x Open Circuit potential

FF (Fill factor) % = Maximum Power / Theoretical Power

$$\textbf{Efficiency (\%)} = \frac{\text{Maximum Power x 100}}{\text{Input power (Solar power) x Surface area of solar cell}}$$



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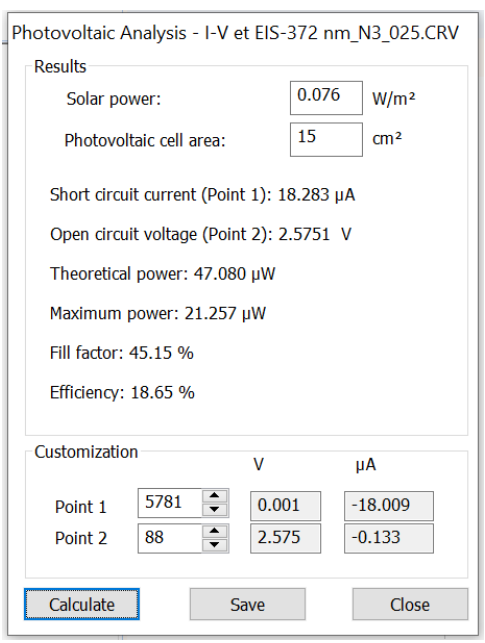

Figure 4: Photovoltaic analysis window

RESULTS AND DISCUSSIONS

Table 1 shows all data extracted from "Photovoltaic Analysis" window, for all 9 LEDs in different wavelengths. The active area of solar cell was 15 cm.

Wavelenght (nm)	ISC (uA)	OCP (V)	Theoretcal Power (uW)	Maximum Power (uW)	Fill Factor %	Efficeincy %
372	18.28	2.57	47.08	21.26	41.15	18.65
390	34.86	3.50	121.97	61.34	50.29	53.81
400	30.91	3.29	101.98	46.13	45.23	30.75
424	34.67	3.40	117.93	58.38	49.50	60.82
449	39.31	3.61	142.20	74.08	52.10	53.69
528	29.51	3.19	94.16	40.18	42.67	78.79
590	17.80	2.49	44.37	15.89	35.81	36.53
624	37.61	3.51	131.93	62.59	47.44	92.73
2740	31.19	3.16	103.45	45.72	4419	66.26

Table 1: comparing data obtained by I-V charecterization on solar cell in front of different light sources

From table 1 it could be found out that solar cell which used to be tested in this application has its highest efficiency in front light 624 nm.

INSTRUMENT AND ELECTRODES

Figure 5: OrigaFlex OGF01A

Electrode setup	
Sample	Panneau solaire, puissance 0.5W
Instrument	OrigaFlex01A
Software	OrigaMaster

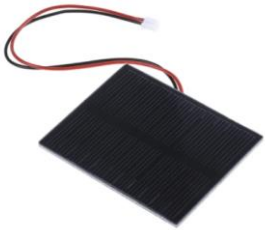

Figure 6: solar cell

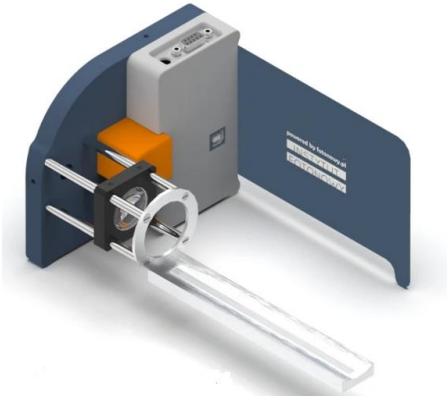

Figure 7: LED revolver

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