I(*V*) characterizations of triple junction devices

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Triple junction solar devices integrated in micro-concentrator solar cells allow to reach very high conversion efficiency. However, due to the reduction of the active area, the ratio of the perimeter to this area increases and so do issues linked to shunt resistances and recombination at the edge of the device. It is therefore important to characterize the influence of the treatments applied to this perimeter to minimize its influence on the final conversion efficiency. For this purpose, *I*(*V*) characterization under dark and under light could be used as a test of the influence of the edge.

We have developed an experiment with which it is possible to record *I*(*V*) curves under different types of illumination. Three lasers at 405, 785, and 980 nm, each with a power adjustable between 0 and 180 mW, can be shone onto a device either one by one, two by two or all together to illuminate mainly one, two or three junctions, the different wavelengths being preferentially absorbed by the top (405 nm), middle (785 nm) or bottom (980 nm) junction. This experiment was applied to devices prepared at Sherbrooke University, these devices being a stack of GaInP/GaAs/Ge with an active area of 3x3 mm^2.

In parallel we have developed a numerical calculation to reproduce the behaviors observed during *I*(*V*) experiments. Each junction was modeled by a series and parallel resistance, a diode, and a current generator. Leakage resistances were added to the model to take account of recombination and shunts at the edges of the device. The comparison between experiment and simulation is shown in Fig. 1.

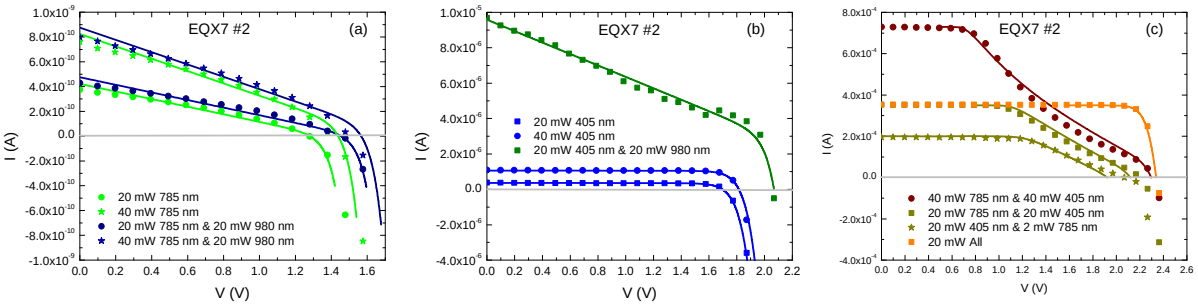

Figure 1. *I*(*V*) experimental results (symbols) obtained on a triple junction device. Laser powers used for the experiment are shown in the figure. The lines are the fits obtained with the numerical calculation.

From the fit of the experimental results with the numerical calculation we have deduced the junction parameters and underlined the influence of leakage resistances.

The *I*(*V*) experiment as well as the numerical calculation will be presented in detail. The parameters that can be extracted from the comparison between experiment and calculation will be shown. It will be also underlined that, combining both methods (experiment and calculation) the *I*(*V*) characteristic of each junction as if it was alone can be determined.