# *Insight into the factors affecting the performances of a conventional GaAs solar cell operating at up to 200 °C*

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In certain configurations, solar cells are operating under thermal stress, i.e. at temperatures far beyond those of the Standard Test Conditions (STC, 25 °C) [1]. In space for near-the-sun missions [2] or in terrestrial photovoltaic -thermal [3] or -thermoelectric [4] or -CSP [5] hybrid systems, cells can reach temperatures from 150 °C up to more than 400 °C. New methodologies aiming at designing, fabricating and characterizing such components are required. The main unknowns are the physical properties of the materials involved and the physical phenomena affecting the photovoltaic conversion performances of cells at such large temperatures.

To contribute to addressing these unknowns, our research work consists in analyzing the performances of conventional GaAs solar cells - optimized in the STC -, but operating under thermal stress (at up to 200 °C). Such cells are fabricated using solid source Molecular Beam Epitaxy and conventional clean room processes, and their performances are characterized by measuring the I-V curves in the dark and under illumination, the spectral response, and the reflectance of the cells as a function of temperature, from 25 to 200 °C.

Factors responsible for the expected degradation of performances with temperature are analyzed using TCAD 1D-simulations and pseudo-3D modeling [6]. The temperature sensitivity of carrier mobilities and contact resistances are examined by Hall effect and CTLM measurements (Figure 1). In particular, we show that the reliability of the methodology for characterizing the contacts is strongly dependent on the number and quality of the samples. Therefore, we propose a novel approach which eliminates some usual simplifying assumptions and considers the propagation of measurement errors by using a Monte Carlo technique (Figure 1-2).

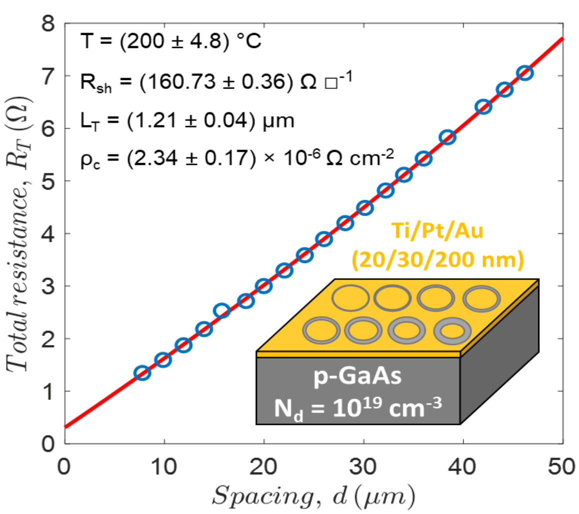


Figure 1. CTLM measurement considering non-linear equations resolution and error propagation. Experimental data (circle) of CTLM measurement for Ti/Pt/Au on p-GaAs at 200 °C, and nonlinear extraction equation (red line). Error bars are not significant enough to be illustrated in the figure.

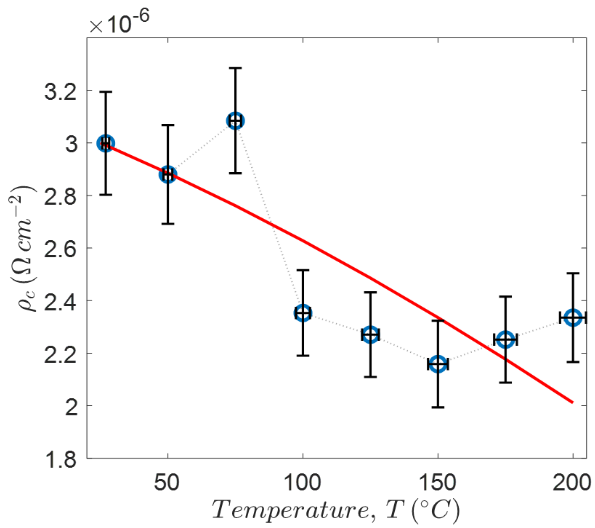


Figure 2. Comparison between experimental specific contact resistivity data (circle) for Ti/Pt/Au (20/30/200 nm) on p-GaAs ($N_d = 1 \times 10^{19}$ cm$^{-3}$) extracted from CTLM measurement and model (red line) with respect to the temperature. AuGeNi on p-GaAs was discarded after similar experiment because the specific contact resistance was too high and presents a lower stability to high temperature.

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