**Influence of a new TCO/Metal contact resistance on a-Si:H/c-Si heterojunction solar cells performance**

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We study the integration of a TCO material which could lead to higher performance for a-Si:H/c-Si silicon heterojunction (SHJ), using the PVD technique from a new target and process recipe [1]. For this purpose, bifacial rear emitter SHJ solar cells have been produced from M2 wafers with 6 busbars configuration using reference ITO and new TCO materials at the hole contact side, batch 1 having a lower defectiveness rate ($G'_d$) than batch 2 [2]. The cells' parameters are determined under standard test conditions. Corresponding test samples with screen-printed pads of different spacings are used for TCO/metal contact resistivity ($\rho_c$) evaluation from the Transfer Length Method (TLM). FF losses are determined from series resistance analysis of passivated contact solar cells [3] and compared to experimental values. The SHJ cells' parameters under illumination for reference condition (ITO, silver paste 1 and standard curing) lead to a 22.5% average efficiency. For a new condition (new TCO, silver paste 1 and standard curing) we observe a 2% abs. efficiency average loss. Correlation between junction side TCO/metal contact resistivity and SHJ cells' fill factor is clearly observed from modelling and experimental data. The main differences between modelling one and two, characterizing the batch one and two, correspond to input parameters from substrate properties as carrier lifetime, carrier density, bulk resistivity and from surface properties as front and rear recombination current. We find that some metal / TCO couples are not suitable for the SHJ cell fabrication leading to a FF reduction up to 7% abs. and $\rho_c$ larger than 200 mΩ.cm². However, when the $G'_d$ parameter is very high, then correlation between FF and contact resistivity becomes difficult to establish. Silicon heterojunction solar cells with low defectiveness rate are essential to get clearly this correlation. Performing paste curing optimization enables to limit this performance reduction while a combination of the new TCO with a second silver paste seems quite promising and compatible with low $\rho_c$ values.

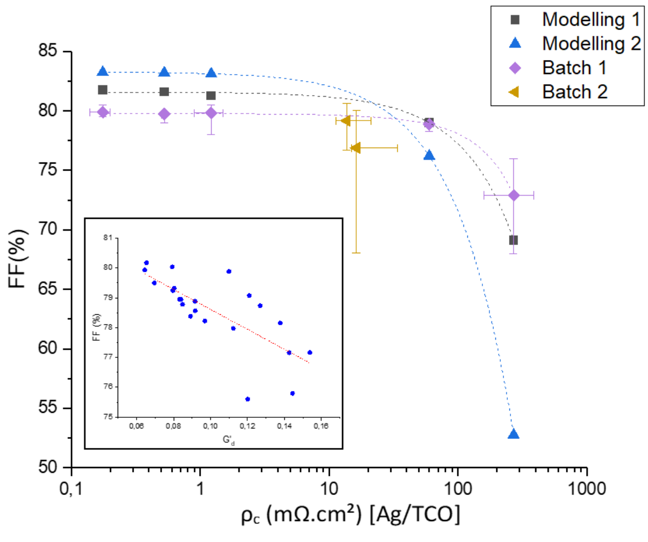


Figure 1: Variation of the FF as a function of $\rho_C(Ag/TCO)$ at the junction side. Experimental trend is compared with data as obtained from Rs modelling approach. The inset gives the FF variation as a function of defectivity parameter ($G'_d$)

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[3] J. Haschke *et al.*, "Lateral transport in silicon solar cells," *J. Appl. Phys.*, vol. 127, no. 11, p. 114501, Mar. 2020