

Determination of best nPERT configuration for thickness reduction through Silicon Solar Cell simulation taking to account bulk quality

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Abstract :

Thickness reduction is one solution to decrease cost of ownership of silicon solar cell. A reduction leading to a 100 μm standard thickness is expected in the future [3]. This reduction were simulated on four configurations of nPERT silicon solar cell thank to Quokka2, a free software distributed by PVLighthouse™[1]. Validation of this simulation tool has been provided [2]. The four configurations arise from the choice of front or rear emitter and mono or bifacial architecture as presented in figure 1. Moreover dependence on bulk quality (bulk lifetime and resistivity) has been studied in function of device’s thickness for each nPERT configurations.

Generally a thickness reduction induces a drop in efficiency due to lower light absorption (Infra-red light is transmitted by thinner silicon substrate) and quality of surface passivation (surface recombination predominance when silicon bulk is reduced). Each cause is respectively responsible of J_{sc} and V_{oc} drop. For the first one, light management for each configuration is assessed by the pathlength enhancement factor. In the second case Free Energy Loss Analysis (FELA) determine the limit thickness under which recombination in volume is no more the predominant mechanism.

Finally results will determine which configuration is most conducive to a thickness reduction taking to account the bulk quality acceptability of such thin device. Furthermore, data provided could be used for determination of a minimal thickness under which cost of ownership will be no more profitable.

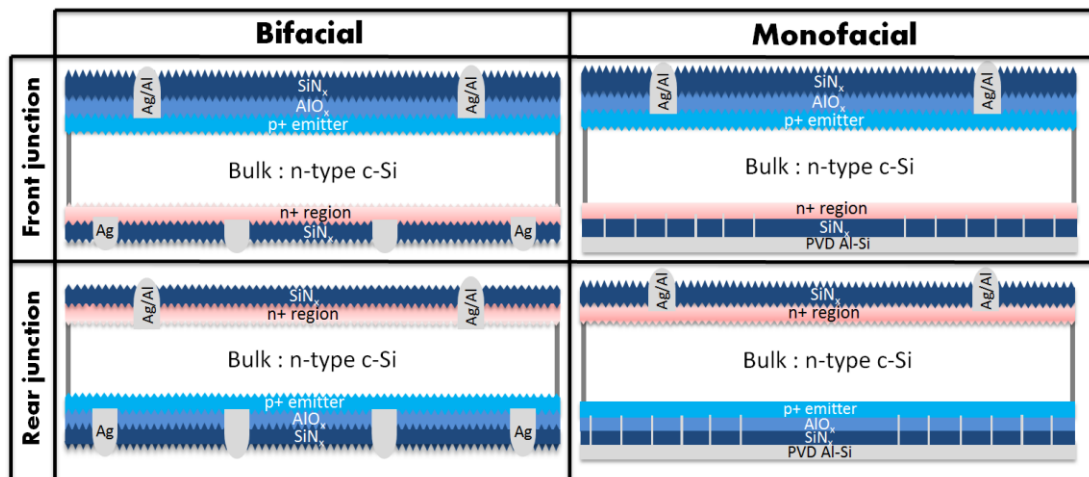


Figure 1: Simulated configurations of nPERT in this study

References

- [1] PVLighthouse™ website (<https://www.pvlighthouse.com.au/calculator-map>)
- [2] A.Fell. “A Free and Fast Three-Dimensional/Two-Dimensional Solar Cell Simulator Featuring Conductive Boundary and Quasi-Neutrality Approximations” *IEEE* vol 60, no2, February 2013
- [3] ITRPV. *International Technology Roadmap for Photovoltaic (ITRPV) 2015 Results*. (2016)