# Toward III-V/Si tandem cells, GaInP top cell optimization

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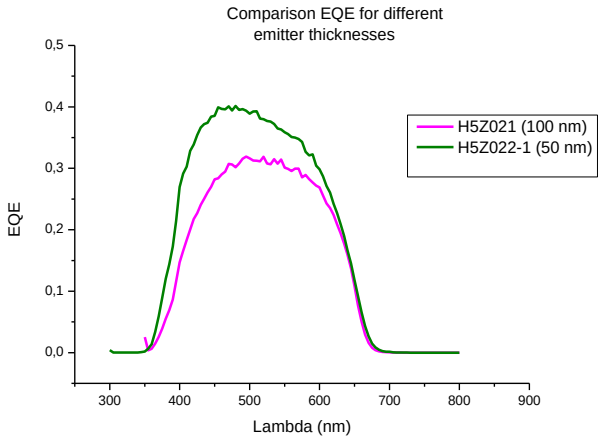
Silicium single junction solar cells are dominating photovoltaics market but are approaching their yield limits. One of the ways to rise solar cells' efficiencies while remaining cost effective leads to tandem solar cells combining III-V and Si materials. GaInP is a good candidate for this purpose, though its properties varies significantly with growth conditions. A GaInP/Si tandem with an efficiency of 32.5% has recently been reported, 0.3% less than the state of art of III/V-Si tandem which is a GaAs/Si cell [1]. Considering the difference in maturity between GaAs and GaInP single junction technology, it is a promising figure.

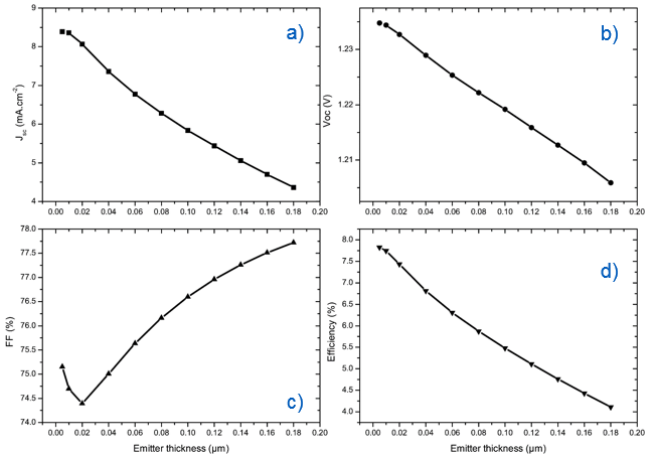
In this communication we detail a study on GaInP cell optimization, both in structure and material quality.

In tandem solar cells it is critical that the top cell harvest short wavelength photons efficiently. It has been shown that thinning the GaInP solar cells emitter can improve its performances in short wavelength range and enhance the cell efficiency [2]. Here we illustrate the gains provided by this method with both cells grown by molecular beam epitaxy at C2N, and modelisation performed at IPVF.

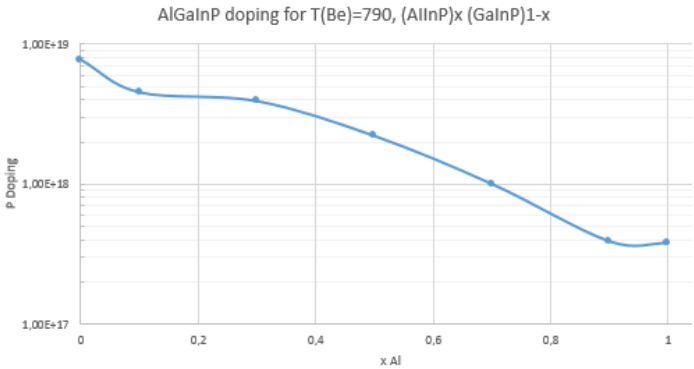
We also develop a study on the p doping of the AlGaInP quaternary alloys to address the compromise needed between minority carriers repulsion for passivation purposes and majority carriers conduction for collection in the back surface field layer. In this study all conditions were kept constant beside the alloy composition during samples growth, though a significant decrease of doping was observed while increasing aluminum content.




(1)




(2)




(3)

Figure (1): EQE improvement from emitter thinning

Figure (2): Cell's parameters evolution depending on emitter thickness. a) $J_{sc}$, b)$V_{oc}$, c) FF, d) Efficiency

Figure (3): p doping variation with AlGaInP alloy composition.

References :

[1] Essig et al, doi:10.1038/nenergy.2017.144

[2] Masuda et al, doi: 10.1063/1.4914046