

# GaAs/AlGaAs core/shell nanowires on Si substrates for photovoltaics: toward an optimized tandem solar cell

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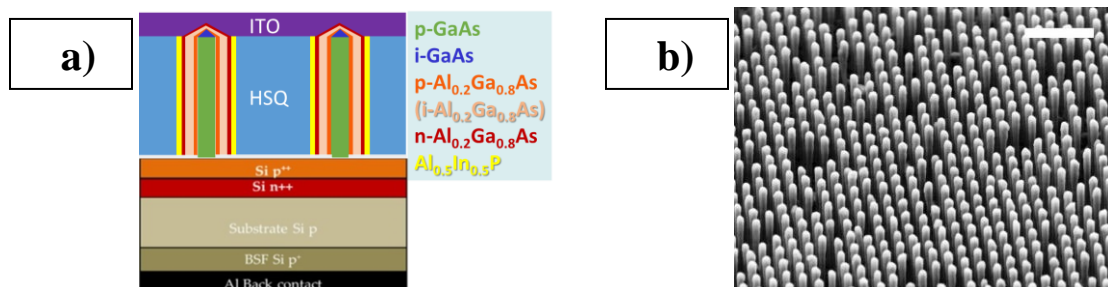
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Since LaPierre's first theorization of a nanowires (NWs)-based tandem solar cell (TSC) on Si substrate,<sup>1</sup> other theoretical studies have been carried out to investigate the high potentialities of such devices,<sup>2</sup> which can virtually reach an efficiency around 34 %. In spite of these very promising results, the research in this field has not yet developed that much on a practical level: to the best of our knowledge only one prototype of TSC has been realized so far by Yao *et al*,<sup>3</sup> and although not completely optimized, it reached the high conversion efficiency value of 11.4 %.

Based on these considerations, we aimed to develop a fully optimized TSC capable to achieve higher efficiencies.<sup>4</sup> This consists in a top cell made of an ordered array of GaAs/AlGaAs core/shell NWs, with a radial p-i-n junction in the AlGaAs shell, directly grown on a bottom cell of Si(111), as shown in Figure 1(a). The optimization work has been carried out in different steps, i.e. theoretical simulations to identify the best set up for the array, optimization of the NW structure, composition and morphology, investigation for the most suitable passivation shell and growth on patterned substrates. The last point has notably lead to significant results, since we develop a protocol to obtain very high vertical yields (from 80 % to 90 %) of GaAs/AlGaAs core/shell NWs on large patterned areas (0.9 cm x 0.9 cm), as shown in Figure 1(b). Following these promising results, we are currently committed to using our ordered arrays of NWs for the fabrication of a TSC, now focusing our work on encapsulating and contacting the nanostructures: despite the complexity of the system, EBIC results in this respect (cf. V. Piazza's abstract) are encouraging and suggest that the realization of the TSC is at our fingertips.<sup>5</sup>



**Figure 1.** (a) Scheme of the ultimate structure of the TSC. (b) Ordered array of p-GaAs core / p-i-n AlGaAs shell NWs on Si(111) with a high vertical yield (80-90 %); white scale bar corresponding to 2  $\mu\text{m}$ .

## References

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<sup>3</sup> M. Yao *et al*, *Nano Letters*, **11** (2015), 7217.

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