# Direct Growth of Crystalline Silicon on GaAs by Low Temperature PECVD: Towards Hybrid Tunnel Junctions for III-V/Si Tandem Cells

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Combining III-V and Si is of high interest to produce tandem solar cells reaching high theoretical conversion efficiencies[1]. With the standard approach, namely the epitaxial growth of III-V on a silicon substrate, crystalline defects caused by the interface polarity issues, the thermal expansion, and lattice mismatches highly prevent from growing a high quality III-V material. We propose here an innovative approach for tandem solar cells, based on the inverse metamorphic growth of crystalline silicon on GaAs[2]. In this approach, we first use MOVPE to grow the AlGaAs top cell on a lattice matched substrate, and then perform low temperature (LT-) PECVD heteroepitaxial growth of Si or SiGe for the bottom cell, as shown in Figure 1. The tandem solar cell is then transferred to a low cost carrier and the GaAs substrate is reclaimed. The main advantages of this technique are that the III-V subcell has a high quality as it is directly grown on a GaAs substrate, and the heteroepitaxy is not subject to the polarity issues encountered in direct growth of III-V on Si. Furthermore, such low temperature c-Si epitaxy prevents from the usual defects induced by the thermal expansion mismatches between the two materials, as it occurs below 200 °C. The LT-PECVD growth technique also allows us to grow highly doped Si on GaAs, which opens up the path to a III-V/Si hybrid tunnel junction. The tunnel junction is a key element to ensure a low resistance and minimum optical losses between subcells. There are many theoretical and experimental studies exploring the tunneling properties of various III-V heterostructures[3][4]. However, the literature about hybrid tunnel junctions (TJ) for III-V/Si multijunction solar cells is very scarce[5][6], despite the huge potential of such devices. Thus, the aim of this work is to study different configurations of the Si/GaAs interface and to find the best architecture for connecting III-V and SiGe subcells in a tandem device, including Si/III-V hybrid tunnel junctions.

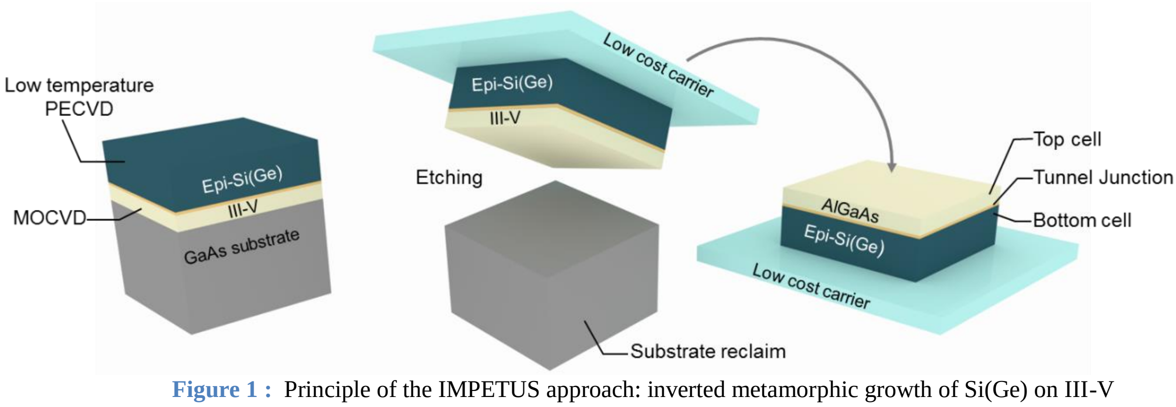


**Figure 1 :** Principle of the IMPETUS approach: inverted metamorphic growth of Si(Ge) on III-V

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