Integration of a GaAs solar cell in a hybrid photovoltaic-thermoelectric system

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A solar cell can only convert a portion of energy from the solar spectrum into electric current. The energy that is not converted into electric current is either not absorbed or lost as heat in the cell, the latest is referred to as thermalization[1]. One way to retrieve this heat loss is to add to the photovoltaic (PV) cell a thermoelectric generator (TEG). This strategy has been used previously [2] and exhibits notable performance improvements when compared to a PV cell alone, although it is still constrained. One of the main causes of performance limitation is the poor thermal conductivity from the PV cell to the TEG and a special focus should be given to the interface between the two parts.

In our case, the GaAs solar cell is made using molecular beam epitaxy which requires a growth substrate with a crystallography matching the structure that will be grown. In the case of a GaAs solar cell, the growth substrate is typically a GaAs wafer. However, the thermal conductivity of these substrates isn't optimal for a PV-TEG system and should be replaced by a substrate with better thermal conductivity.

We will present our progress on the technological process to transfer a GaAs photovoltaic cell on a copper host substrate while ensuring ohmic electric contacts on each side of the PV cell. The process is summarized in Figure 1. We will focus on three steps that we identified as critical. Firstly, the deposition of the cell's back electric contact to serves both as an electric contact and a support for the bonding with the copper substrate. Then, the wafer bonding using a thermocompression process that can also ensure the annealing of the back contact. Finally, the removal of the growth substrate by selective chemical etching.

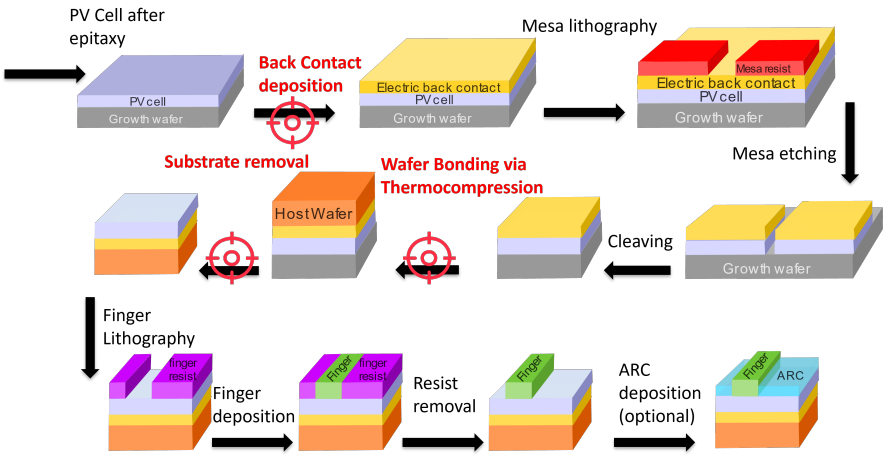

Figure 1: Graphic summary of the full process proposed to transfert a GaAs photovoltaic cell from a growth substrate to a host substrate. (red) steps identified as critical

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