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

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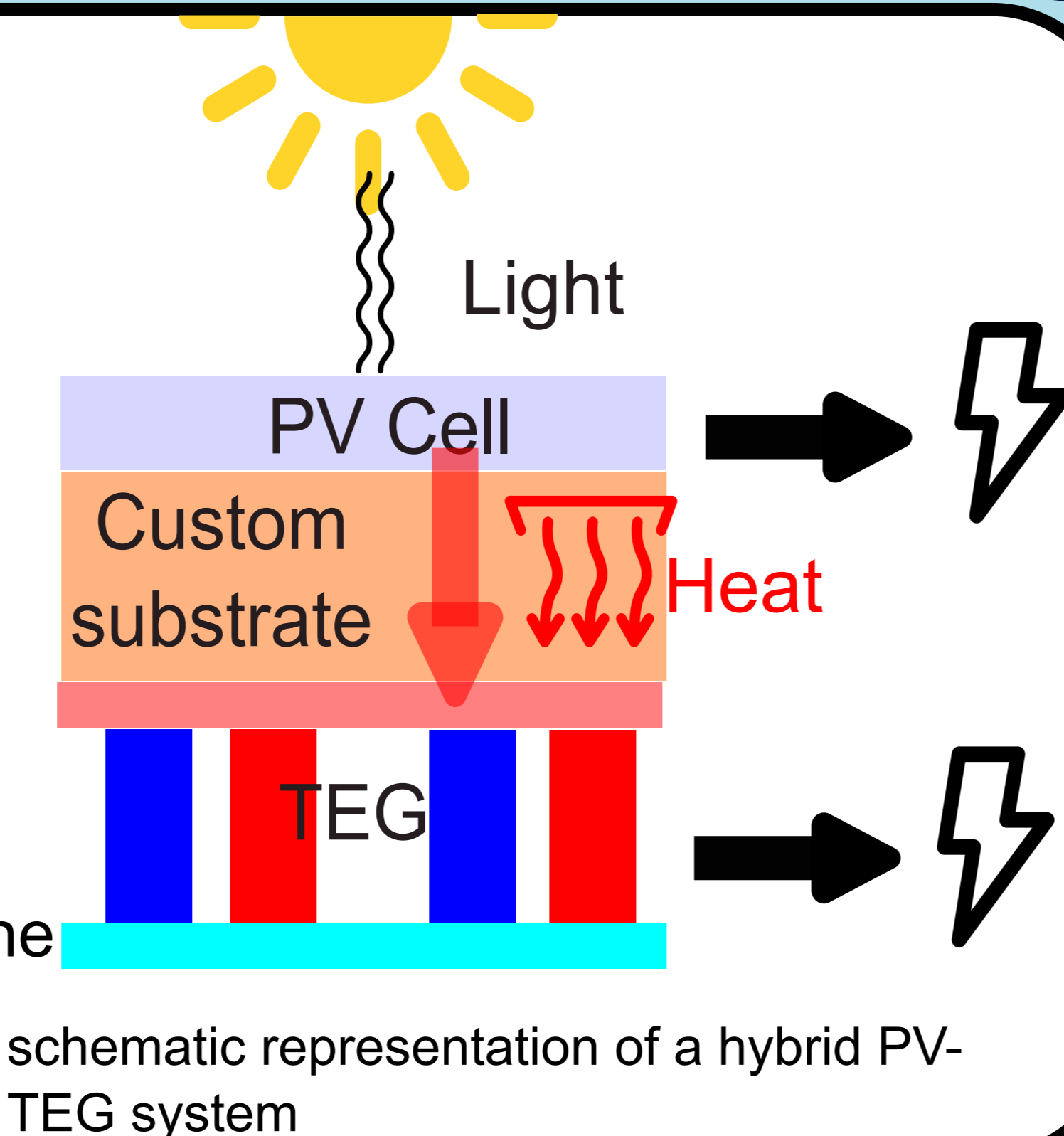
Context

Photovoltaic cell (PV) converts only partially energy above the bandgap into electricity.

The rest is either not absorbed or converted into heat.

Infrared part of the spectrum is not absorbed.

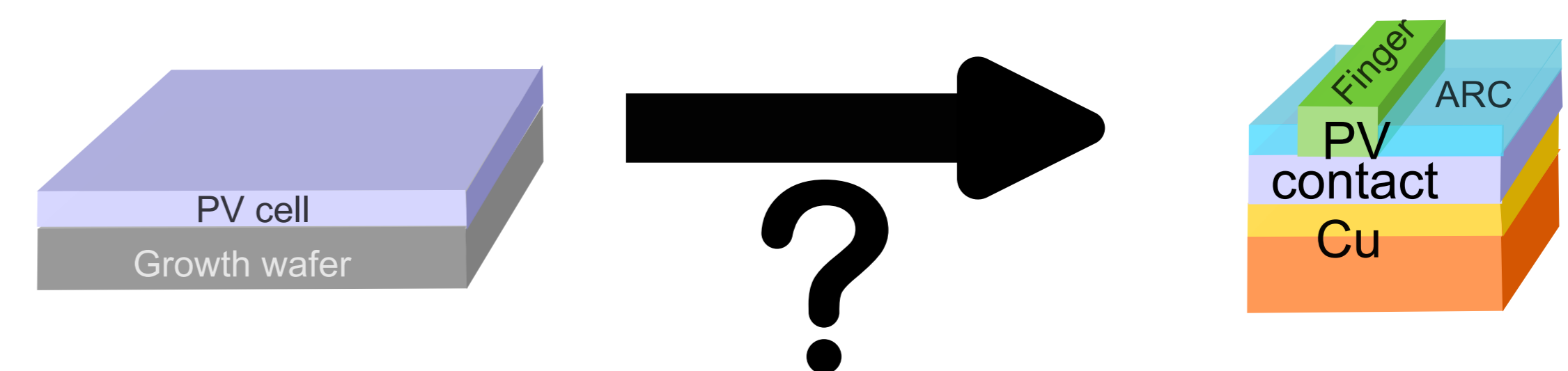
Excess heat loss is converted with the thermoelectric generator (TEG) via Seebeck effect [1].



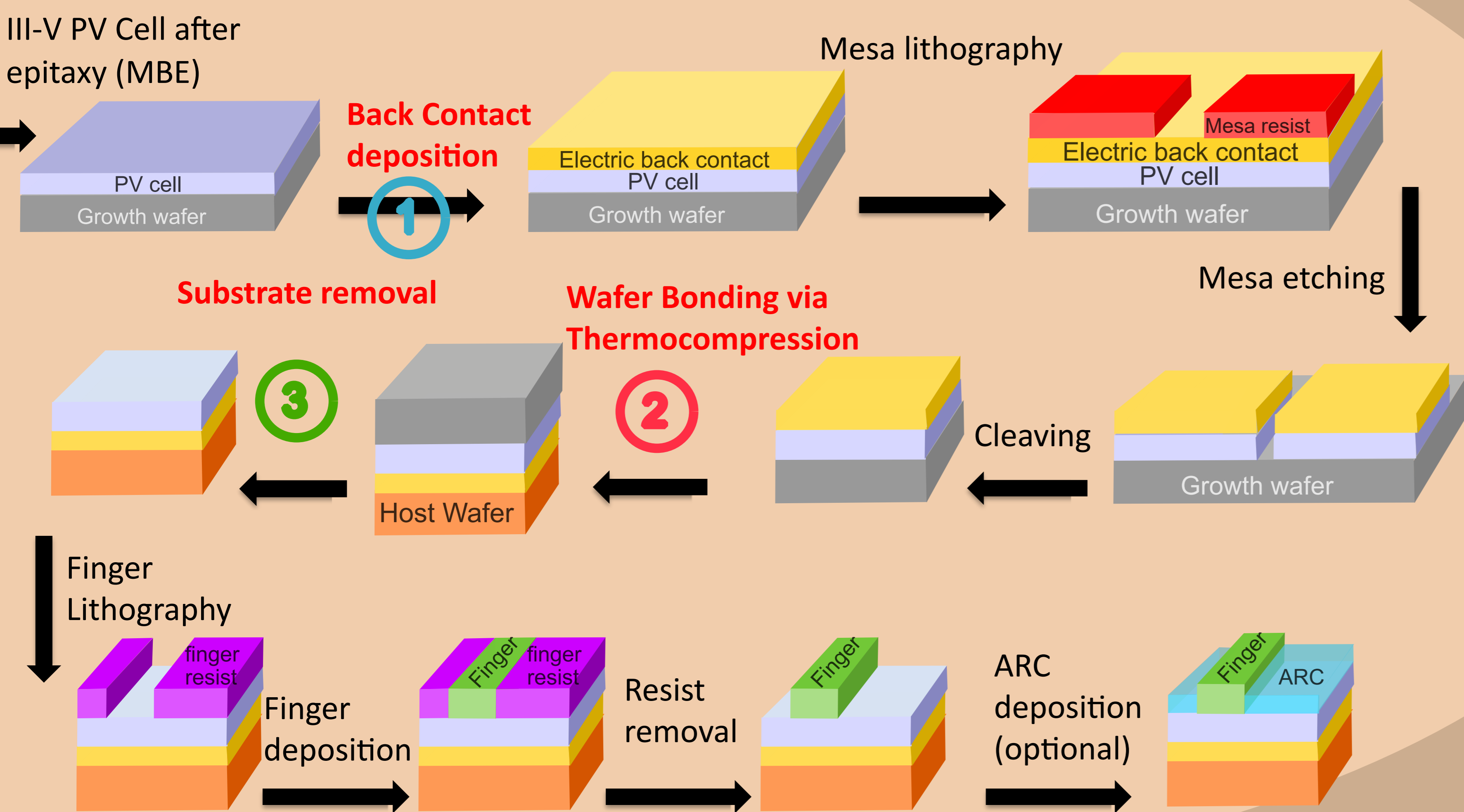
Objectives

Create a PV cell optimised for integration in hybrid PV-TEG system

- Use of a thermally conductive substrate
- Reduce thermal resistivity at the PV-TEG interface

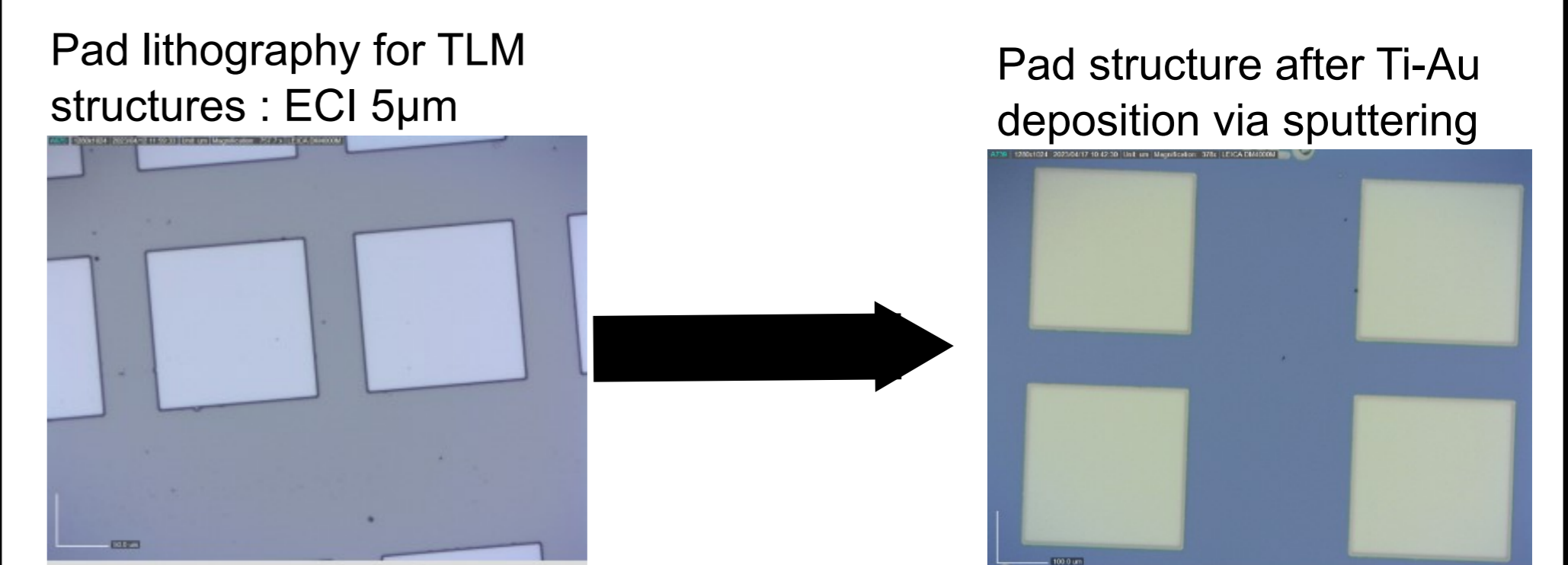


Process for design and transfer of a PV cell onto a host substrate



Back contact deposition

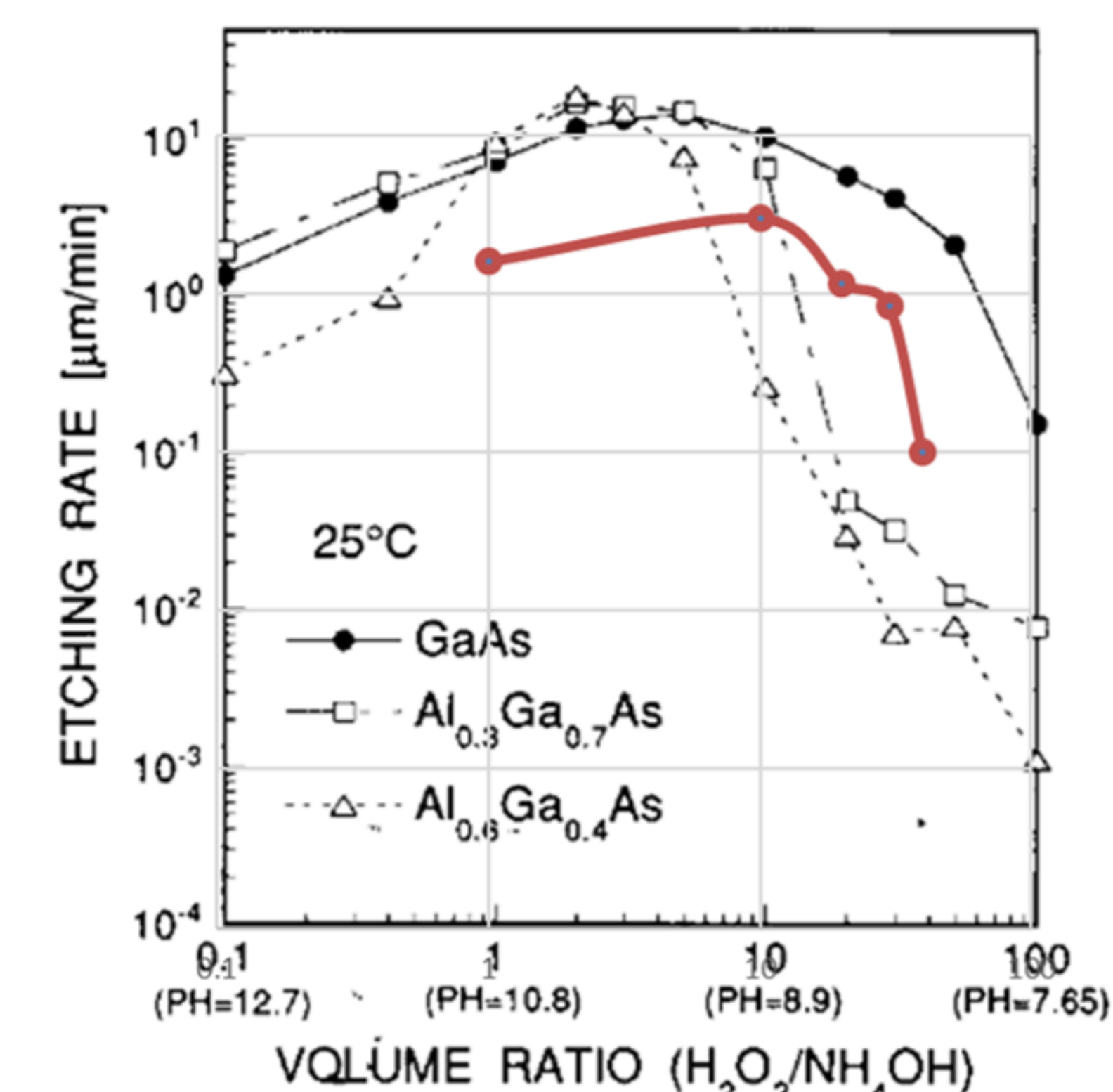
- Metal deposition via sputtering
- Contact resistivity checked via transfer length method (TLM)



TLM measurement on probing bench

Wafer etching

Selective etching of GaAs/AlGaAs using $\text{NH}_4\text{OH}(30\%):\text{H}_2\text{O}_2(\text{xx}\%)$



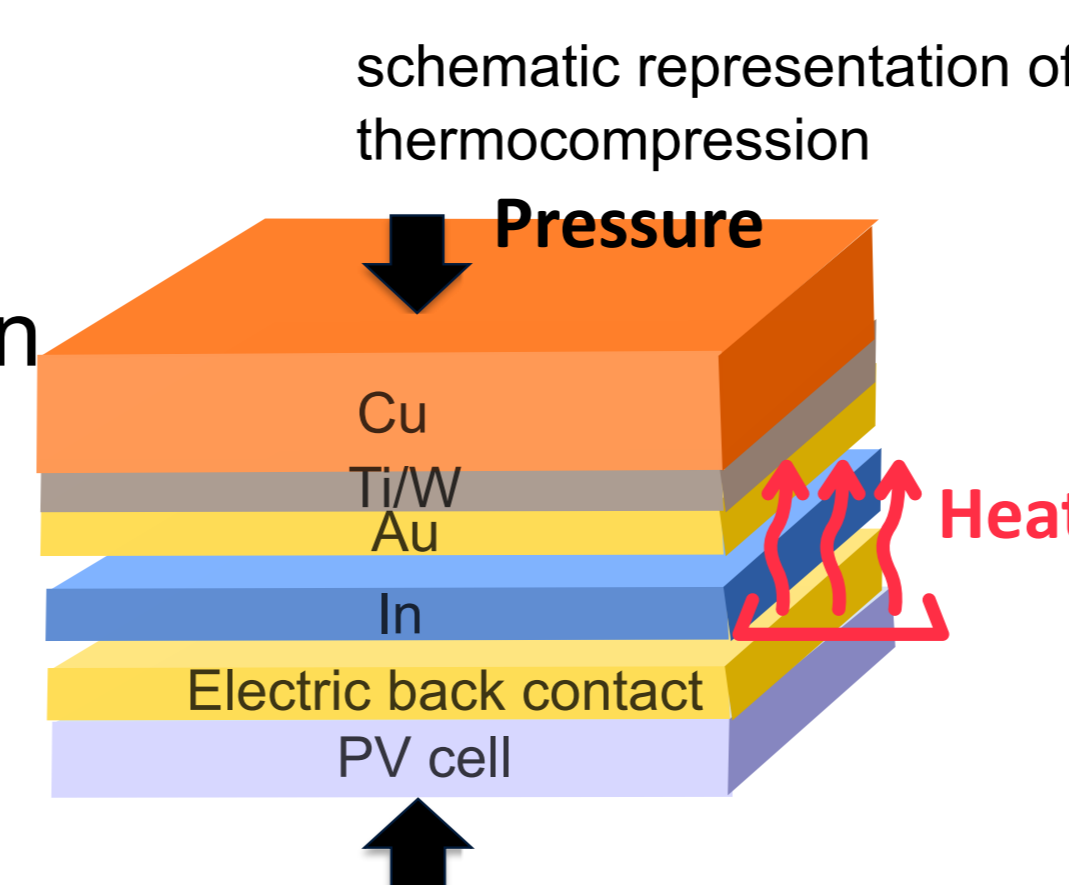
(black) values obtained by Uenishi et. al [3]

(red) GaAs etching rate for etching time up to 4h

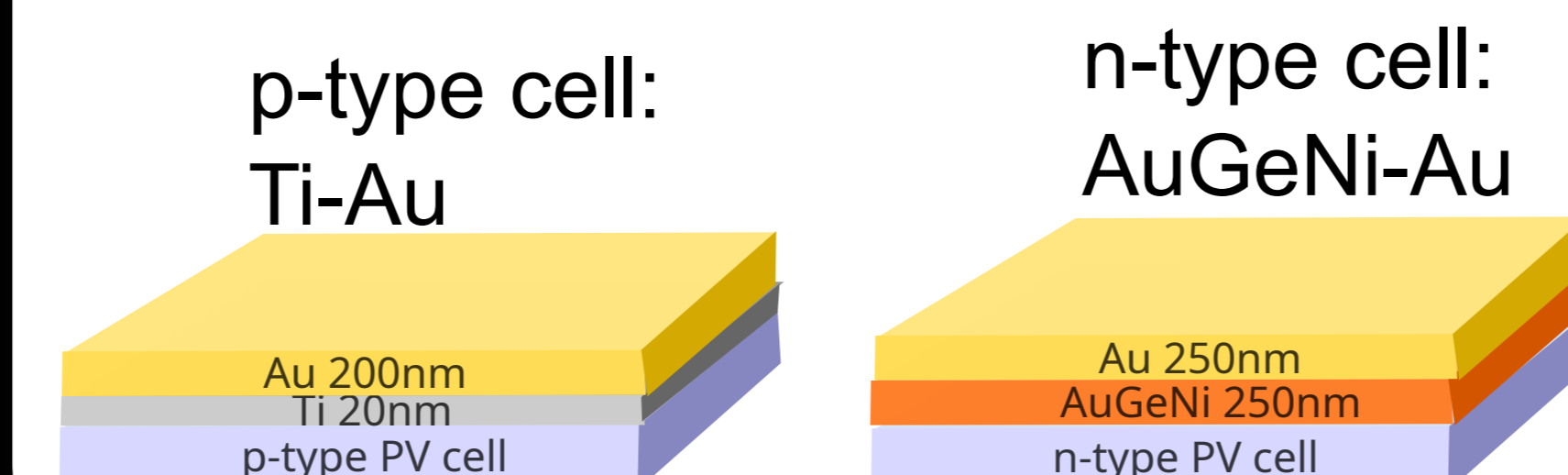
Thermocompression

We use thermocompression as both a wafer bonding step and an annealing step for the electric back contact.

Bonding done via interdiffusion Au -Au



2 types of contact



Conclusion & Perspectives

- Original process to integrate a PV cell into a hybrid PV-TEG system
- Multiple technological challenges: wafer etching, wafer bonding, metallic contact deposition
- Multiphysics approach needed to quantify the improvement compared to classic PV-TEG system

References

1. Narducci, D., Bermel, P., Lorenzi, B., Wang, N. & Yazawa, K. vol. 268 (Springer International Publishing, 2018).
2. Pohl, U. W. . (Springer Berlin Heidelberg, 2013). doi:10.1007/978-3-642-32970-8.
3. Uenishi, Y., Tanaka, H. & Ukita, H. IEEE Trans. Electron Devices 41, 1778–1783 (1994).