« Exchange of Experiences » - Webinar

Insights, outcomes and results – 28 September 2023

BOBTandem

Band Offset selective Barrier Three Terminal perovskite on silicon high efficiency Tandem Solar Cell

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Project aim: Band Offset selective Barrier Three Terminal perovskite on silicon high efficiency Tandem Solar Cell

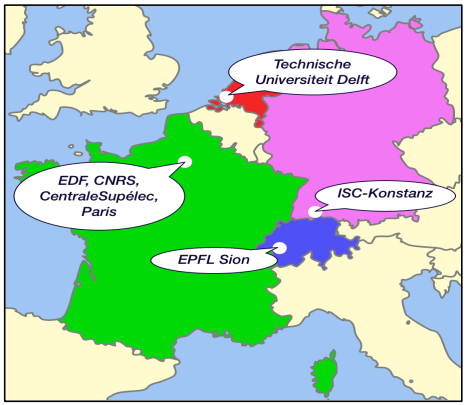
Call : Call Solar-Era.net cofund 2

Project topic : Emerging PV technologies - B1. Silicon-based tandem technologies, namely with perovskites and III/V semiconductors

Elements

IBC - Interdigitated back contact solar cell	TRL ≈ 9 (in production)
PSC - Perovskite solar cell	TRL ≈ 5 (pilot lines in development (CH, DE)).
SBOB - Carrier selective band offset barrier	TRL ≈ 5 (concept in production for detectors)

=> Resulting project TRL : 5 - technology validated in relevant environment



The collaboration :

- Restricted participation (due to list of collaborating countries)
- Close collaborators from past proposals (H2020, COST) could not be considered

BOBTandem concept :

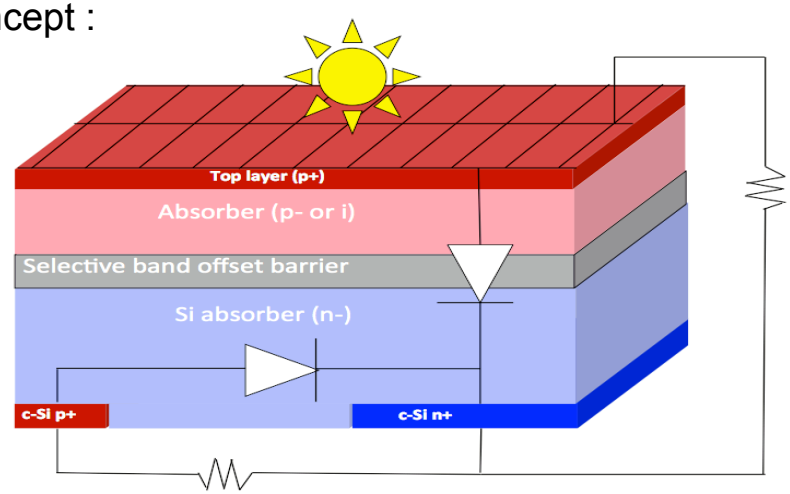


Figure 1 : The BOBTandem device

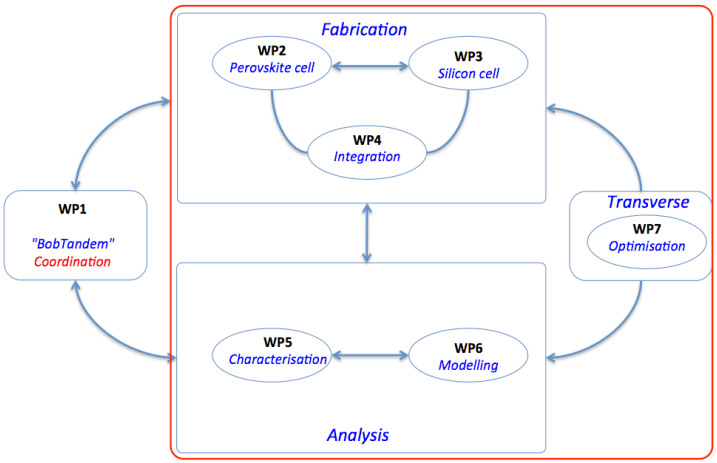


Figure 2 : BOBTandem project structure and interactions

(1) Perovskite PSC : Close to production (EPFL) efficiency ≈ 24%

(2) Selective barrier BOB : **Novel concept**[1] in solar cells (patent)

(3) Silicon IBC : In production (ISC) efficiency ≈ 22%

=> Theory : Expected efficiency above 30%

[1] J.-P. Kleider et al, European PVSEC 2018, DOI : 10.4229/35thEUPVSEC20182018-1AO.2.4

BOBTandem achievements :

Year 1	IBC ZEBRA process adapted	✓
	PSC and integration on IBC process defined	✓
	Characerisation of surfaces and interfaces planned	✓
	IBC and PSC modelling	✓
	Materials modelling of PSC and interfaces	✓
Year 2	IBC optimised and delivered	✓
	PSC/IBC first integrated device	✓
	Integrated PSC+IBC device modelling	✓
	3T device characterisation in place	✓
Year 3	Deliver optimised 3T device	✗
	Energy yield modelling	✓
	Advanced device characterisation	✗
	PSC materials modelling	✓

Bottlenecks : PSC materials and integrated devices
Part achieved : Advanced characterisation (2 photon PL, XPS)
Missing : Deliverables and milestones : 6 of 30 – *some critical*

BOBTandem experiences gained :

Project success stories

• Modelling development on three fronts : Materials ; Device ; Sytems and optics	*(GeePs, TUD, EDF)*
• Rapid prototype development ahead of schedule	*(EPFL)*
• IBC technology development and adaptation for tandems	*(ISC - Konstanz)*
• Dissemination : EUPVSEC presentations, joint journal publication, more in progress	*(All)*
• *Horizon Europe projects resulting (one threshold passed but not (yet) funded, the other funded)*	*(GeePs)*
• *National projects resulting funded (ORGANIST 2023 – 2026, IOTA (PEPR) and MINOTAUR (PEPR))*	*(GeePs, ISC-Konstanz and collaborators)*

Critical factors and lessons learned :

Critical factors :

Fabrication :
- Material and device shortfall : COVID lab shutdown crippled sample fabrication : 20% lack of latter deliverables/milestones

Communication :
- Visio meetings insufficient : Due to COVID only kickoff and final meetings were in person.
- Remedial action in critical phases : integration and advanced characterisation. Specific : interfaces.

Lessons learned

Project workplan :
- Follow plan, avoid short cuts taken on rapid first results − example of no dummy devices studied.
- Smaller steps in critical phases : integration and advanced characterisation. Specific : interfaces.

Coordination :
- More reactive risk mangement and remedial actions
- More action on publications

Conclusions

- Design phase on time and successful
- Early devices delivered ahead of schedule
- Multiscale analysis achieved : from atomistic to device to system models
- COVID obstacles poorly managed : experimental validation not achieved

=> A mixed success but ongoing : followup projects underway

=> First lesson learned : be more reactive to unexpected crises

=> Transnational aspects : encourage greater participation than "Old Europe"