Competence Centre Thin-Film- and Nanotechnology for Photovoltaics Berlin

The 30 x 30 cm² R&D baseline for high efficiency CIGS thin-film modules at PVcomB

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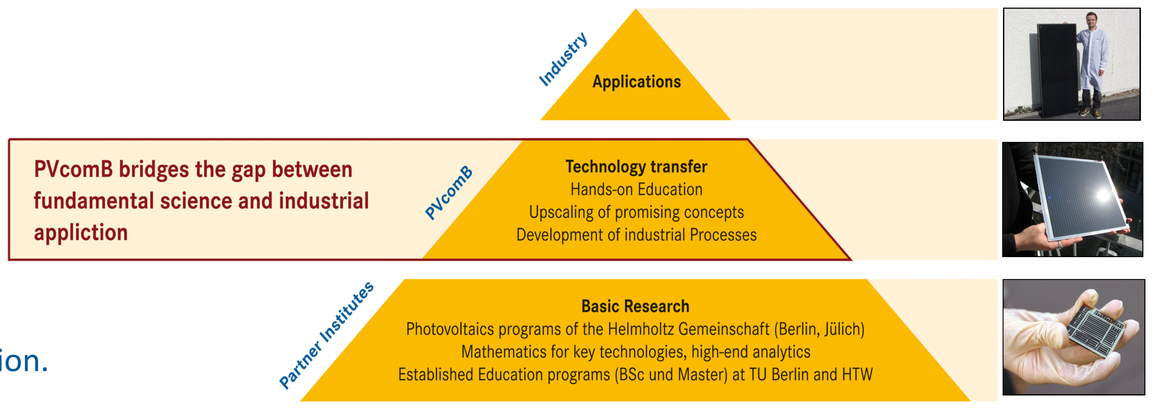
Our Mission

- Technology transfer from innovative lab sized solar cell concepts to industrially produced modules and vice versa.
- Two R&D reference lines **CIGS (this presentation)** and **a-Si/µc-Si** (see **3DV.2.36**) for 30 x 30 cm² glass modules.
- Whole process chain from glass washing to module encapsulation.
- Sequential processing for CIGS absorber formation
- Advanced tools for *in situ* and *ex situ* process analytics and high level device characterization.



Deposition of (CuGa, In) precursor layers and metal back contact

A600V7

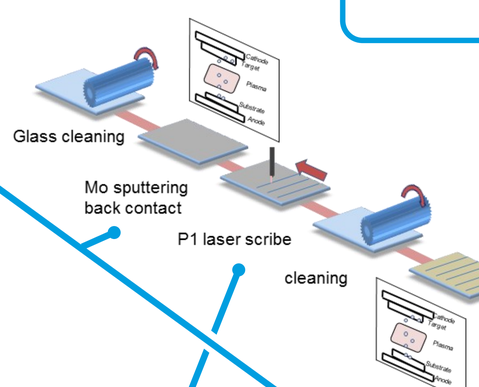
- Inline sputter tool from Leybold Optics Dresden for 30 x 30 cm² module size
- 4 planar (CuGa, In, Mo, Mo:Na) & 2 rotatable (Si) magnetron positions for precursors, contact and barrier layers
- Sixfold carrier magazine/2 substrates per carrier: high throughput & high reproducibility

Selenium deposition

- Thermal evaporation of selenium pellets in vacuum
- Up to 3 full size 30x30 cm² substrates

Selenization (RTP)

- Fast heating (4 K/s)
- Separate heating zones for T control
- Vacuum or inert gas atmosphere



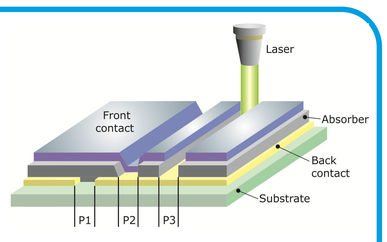
Chemical deposition and etching

- Wet-chemical deposition of CdS buffer (automatic batch process)
- Alternative (Cd-free) buffer (e.g. by ALD)

TCO front contact deposition

- Inline sputter tool from Von Ardenne Anlagentechnik Dresden for 30 x 30 cm² modules.
- i-ZnO layer by RF sputtering

Laser and mechanical scribing



Joint laser lab of HTW and PVcomB.

- High performance laser- and needle-scribing tool from Rofin Baasel Lasertech
- Laser sources with pulses at µs (1064 nm), ns (532 nm) and ps (1064, 532 & 355 nm) timescale.

see also **3.CV.1.6/3.CV.1.34/3.CV.1.42**

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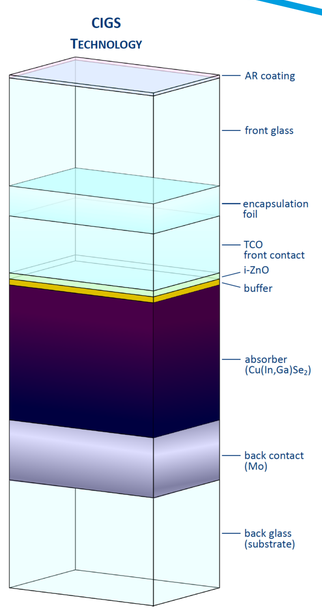
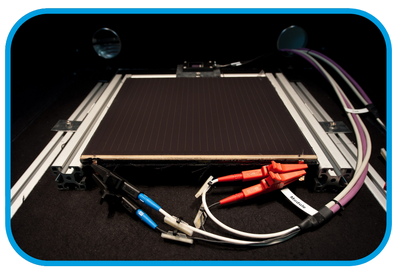


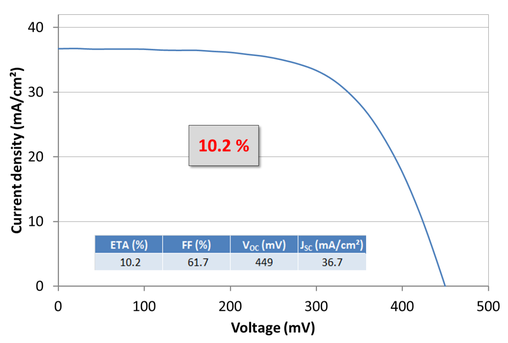
- At **PVcomB** state-of-the-art CIGS modules are developed in a semi-industrial environment, addressing issues such as process stability, throughput, statistics and reliability.
- At **PVcomB** an excellent basis for cooperation with fundamental researchers as well as industrial partners has been created.
- **PVcomB's** baselines offer an ideal reference for the implementation of new materials, process steps and technologies.

Advanced analytics for device and process optimization



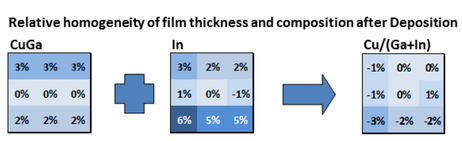
Wide range of state-of-the-art analytics, e.g.

- AAA dual-source WACOM solar simulator
- AAA dual-source h.a.l.m. flasher
- Dual-source EQE with bias-light
- XRF, lock-in thermography (DLIT, ILIT), EL, UV-VIS, Raman, LBIC, ARS, Hall
- 1D/2D/3D device modelling e.g. Ga grading performance regimes



IV characteristics of the best CIGS solar cell (1.4 cm²) prepared on the recently completed CIGS baseline at PVcomB.

Relative homogeneity of film thickness and composition after Deposition



Film thickness and composition after RTP

	CIGSe	Cu/III	Ga/Cu+Ga	Ga/III	Se
	[µm]				[at%]
Inhomog	9,5%	5,1%	3,0%	5,3%	4,3%
Median	2,25	0,82	0,22	0,22	52,4
w/o corners					
Inhomog	3,7%	3,2%	1,1%	4,4%	2,2%
Median	**2,26**	**0,82**	0,22	0,22	52,48

Lateral homogeneity of thickness and composition of CIGS precursor and absorber layers (30 x 30 cm², measured by XRF).

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HZB Helmholtz Zentrum Berlin

GEFÖRDERT VOM Bundesministerium für Bildung und Forschung

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