
ZEB Living Laboratory

Building Integrated Photovoltaics - Challenges and Opportunities

- A Brief 7 Min Presentation


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”Future solar cell materials may also be envisioned as thin laminate or paint layers, hence also enabling application by paint brush or spray” (Jelle et al. 2012).

An idea may be to fabricate a ”solar concentrator” at a microscopic material level embedded in the solar cell surface and beneath (Jelle et al. 2012). Now solar concentrators are down at centimetre and millimetre level (e.g. 25 mm, Baig et al. 2015).

Samfoto (Lisø and Kvande 2007).

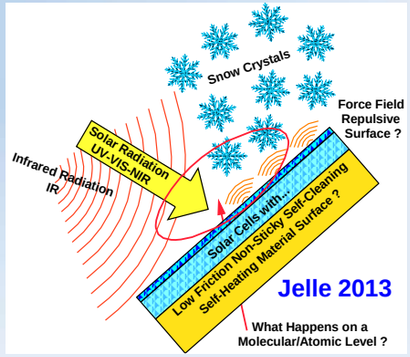
Building Integrated PhotoVoltaics (BIPV)

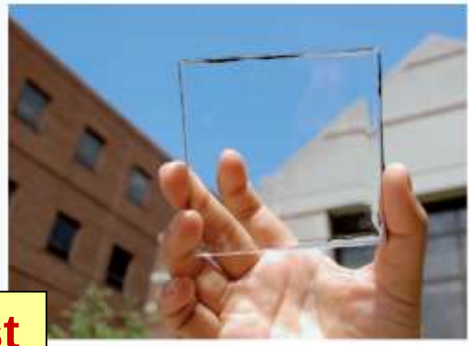
Scanpix (Lisø and Kvande 2007).

- Replace the outer building envelope skin, i.e. both a climate screen and a power source generating electricity.
- Fulfil the requirements of both:
  - Building envelope.
  - PV solar cells.
- Durability in general and vs. climate exposure factors.
- Rain, air and wind tightness, various building physical aspects like heat and moisture transport, etc.

At what angle does it start to slide?
Ice Slab on Glass

Solar Thermal Magazine 2010.





Mourant 2014.

- **BIPV Categorization:**
- BIPV foil products.
- BIPV tile products.
- BIPV module products.
- Solar cell glazing products.
- BAPV products.
  attached / added / applied

Alwitra GmbH & Co.

SRS Energy

Creaton AG

Hauptsitz

Sapa Building System

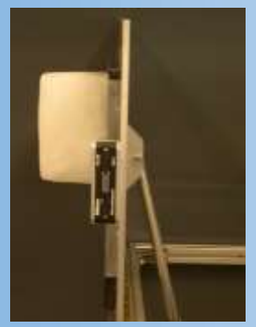
BIPV at its Uttermost

”Ultimately, we want to make solar harvesting surfaces that you don’t even know are there.”
(Richard Lunt, Michigan State University (Mourant 2014))

BIPV and PV Development

PaP BIPV

- **Plug-and-play BIPV (PaP BIPV):**
- **Individual panels (e.g. tiles) clicked/snapped together in a single and simple operation.**
- **Ensuring both satisfactory electrical connections and weather tightness.**
- **Likewise when removing individual panels.**
- **Would definitely gain a competitive edge over today's more traditional BIPV products.**
- **Residential buildings and larger building complexes.**
- **Erection of new buildings and retrofitting of old ones.**
- **Contribute to the acceleration of utilization of solar energy by solar cells on a worldwide scale.**

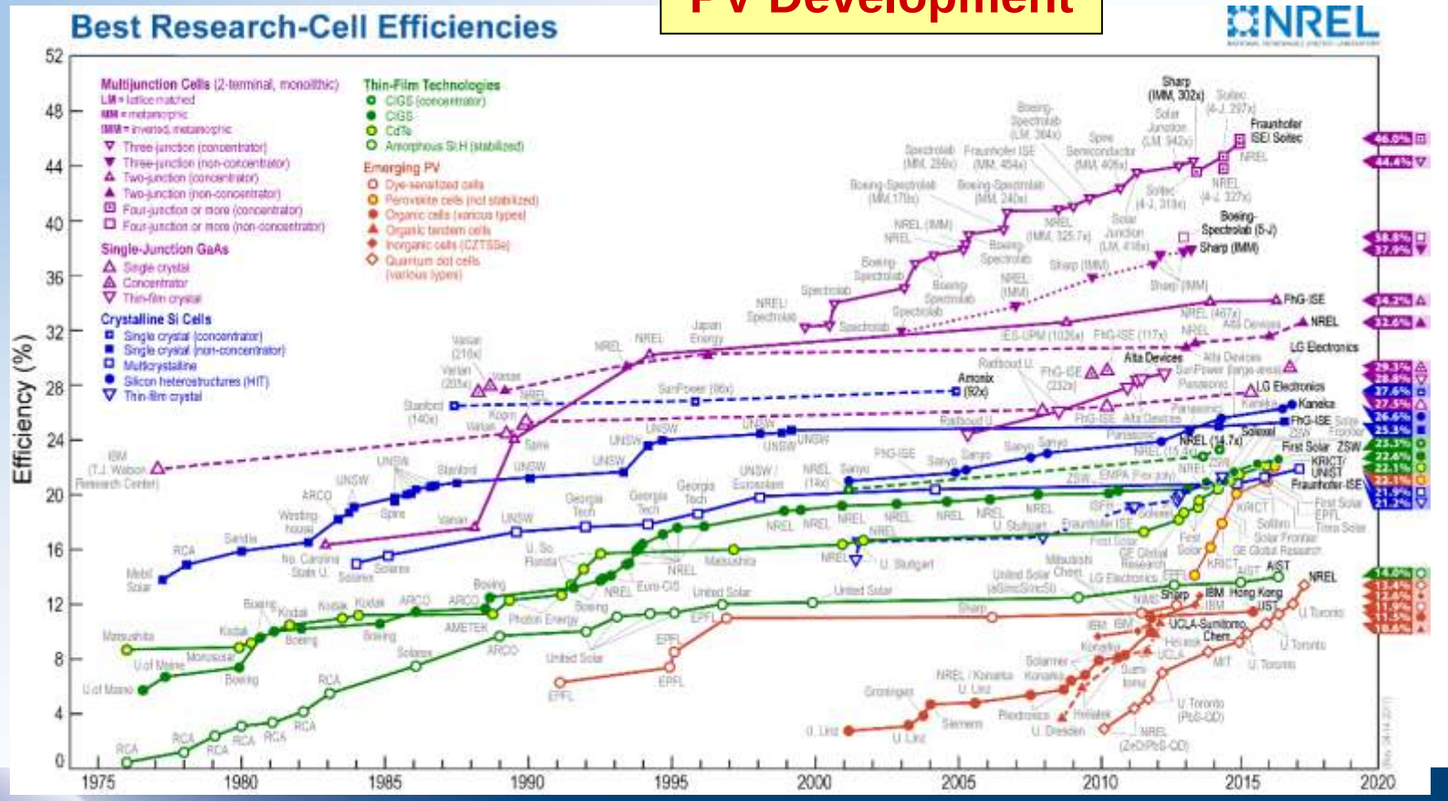


Ice Slab on Glass

Still holding on at 90° !!!

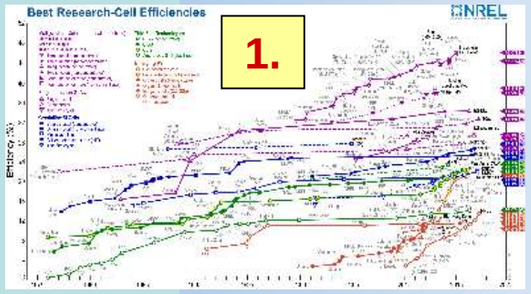
The German company PVflex Solar GmbH has said that ***"thanks to flexible lamination, CIGS solar cells now have the ability to both realize their potential as the most efficient thin film technology and to dominate the building-integrated photovoltaics (BIPV) market in the future"*** **(Stuart 2010).**

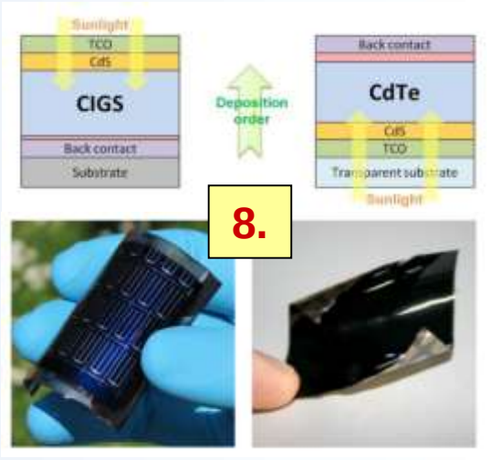
PV Development

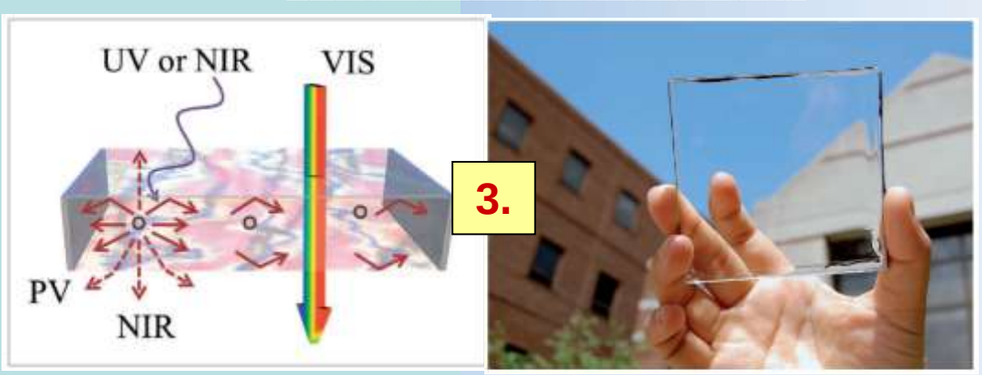


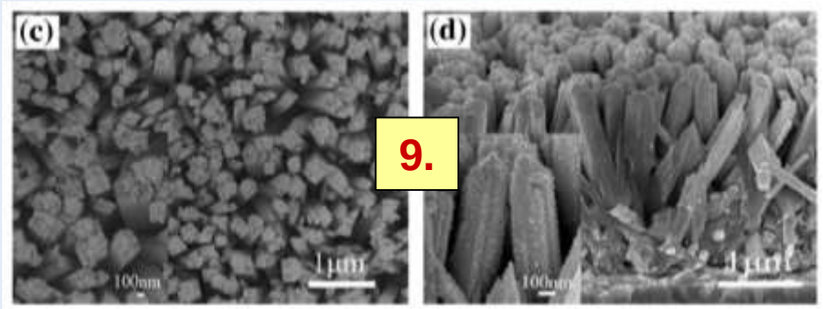
Materials Science Challenges and Opportunities

1. PV development impact on BIPV.
2. High-performance solar cells.
3. Absorbing non-visible solar radiation.
4. Sandwich solar cells.
5. Polymer solar cells.
6. Dye sensitized solar cells.
7. Antenna-sensitizer solar cells.
8. CIGS and CdTe solar cells.
9. Quantum dot solar cells.
10. Solar cell concentrators.
11. Inverted pyramid texturing.
12. Concrete and PV integration.
13. Solar cell paint.
14. Hybrid solar cells, e.g. perovskites.
15. Electrochromic PV devices.
16. Self-cleaning, icephobic and snowphobic surfaces.









See fig. refs. in ABS 2017 article:
B. P. Jelle, "Building Integrated Photovoltaics: A Review of Materials Science Challenges and Opportunities", Proceedings of 12th Conference on Advanced Building Skins (ABS 2017), pp. 1360-1369, Bern, Switzerland, 2-3 October, 2017.