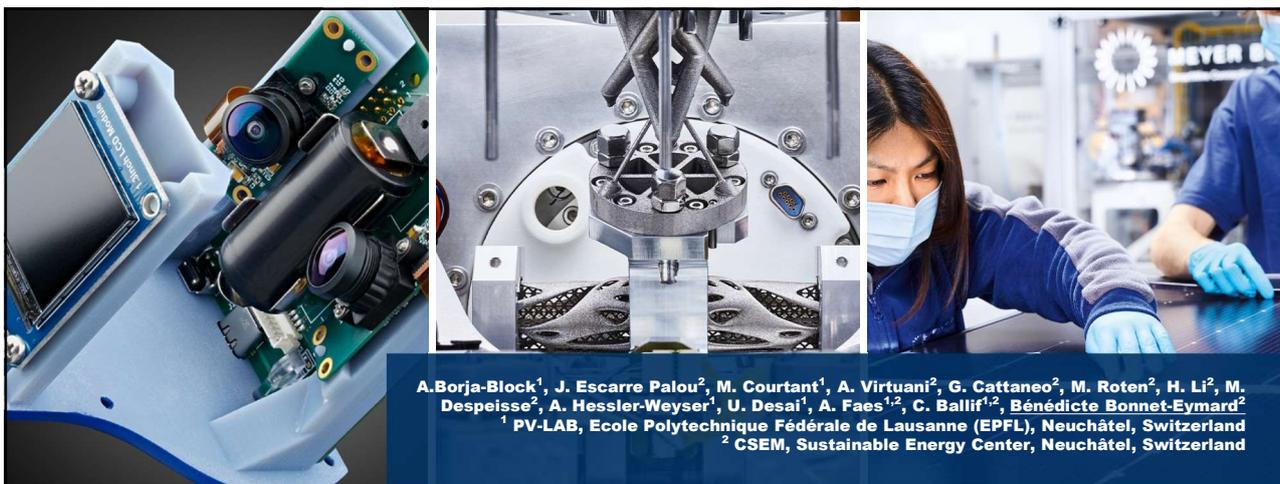


SCHWEIZER PHOTOVOLTAIK-TAGUNG 2025





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COLORATION TECHNOLOGIES FOR BUILDING-INTEGRATED PHOTOVOLTAIC MODULES: AN OVERVIEW

2 avril 2025

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LA SUISSE ET L'ESTHÉTIQUE

> 8% of the distributed market was integrated in 2024 in Switzerland*

Expected BIPV growth in CH**:



Year	Expected BIPV Capacity (MWp)
2023	62
2028	96



3S Swiss Solar Solutions

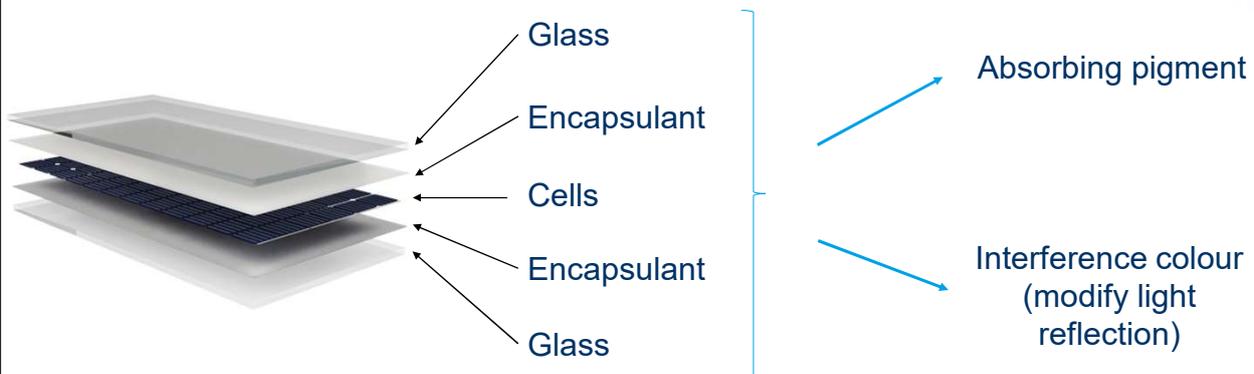
climacy

FREE SUNS SOLAR ENERGY

*pronovo.ch / ** BIPV, A practical handbook for solar buildings' stakeholders, SUPSI, 2024

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HOW CAN WE BRING COLOURS IN MODULES?



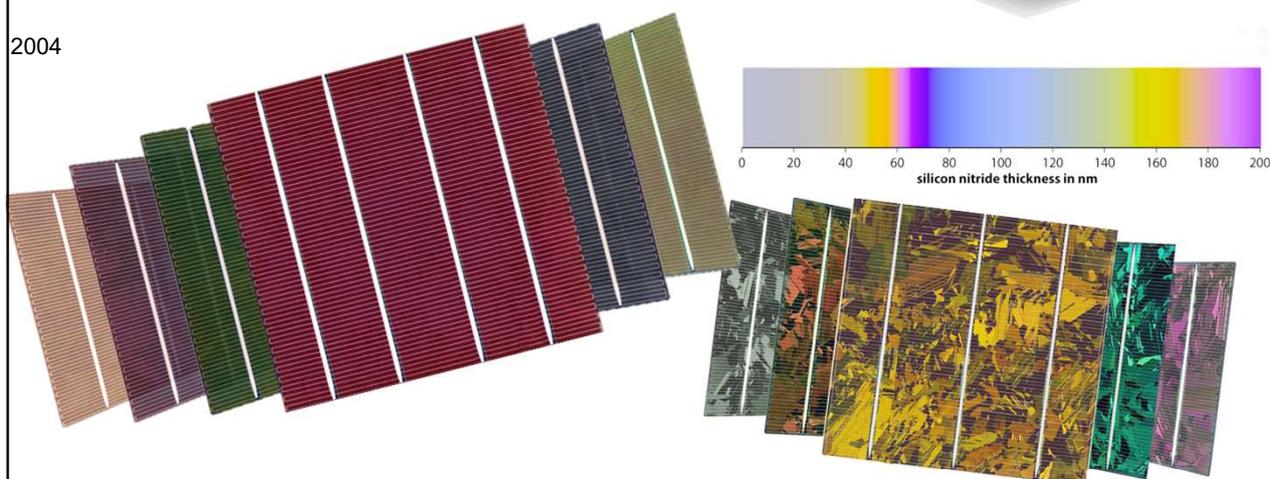
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COLOURED CELLS

2004



Coloured crystalline Si cells by playing on antireflection coating thickness

6

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COLOURED FOILS

SOLAXESS
WHITE & COLOR SOLAR TECHNOLOGY




Urdorf



Genève

Selective diffusion filter for infrared light and nanotechnological film to reflect light

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COLOURED FOILS

SOLAXESS
WHITE & COLOR SOLAR TECHNOLOGY




3S

Zürich



La Chaux-de-fonds

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COLOURED FOILS

FREE SUNS
SOLAR ROOFS




Ferlens (VD)



Bioley-Magnoux (VD)

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COLOURED FOILS - ART

Compáz (CH) **BE SMART**






COLOURED GLASS

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KameleonSolar

Close-up

- Glass
- Encapsulant
- Cells
- Encapsulant
- Glass

Wuppertal - DE

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Digital Ceramic Printing(DCP)

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COLOURED GLASS

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KameleonSolar

with a touch of soltech

- Glass
- Encapsulant
- Cells
- Encapsulant
- Glass

Spreitenbach, CH

Genk, BE

Middelburg, NL

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Digital Ceramic Printing(DCP)

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COLOURED GLASS



INTEFFERENCE COLOR

MERCK

Ceramic Colors
Wolbring



Special colored pastes for screen printing with mica flakes coated with a thin layer of titanium dioxide (photonic pigments)

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COLOURED GLASS



INTEFFERENCE COLOR

Kromatix™

PRINTING



Amsterdam

Lausanne

Copenhagen, DK

Nanotechnological surface treatments

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COST: PV AS CONSTRUCTION ELEMENT

BIPV = combining functionalities

Cover

Energy production

COST = BIPV element – cover material being replaced – electricity production - subsidies

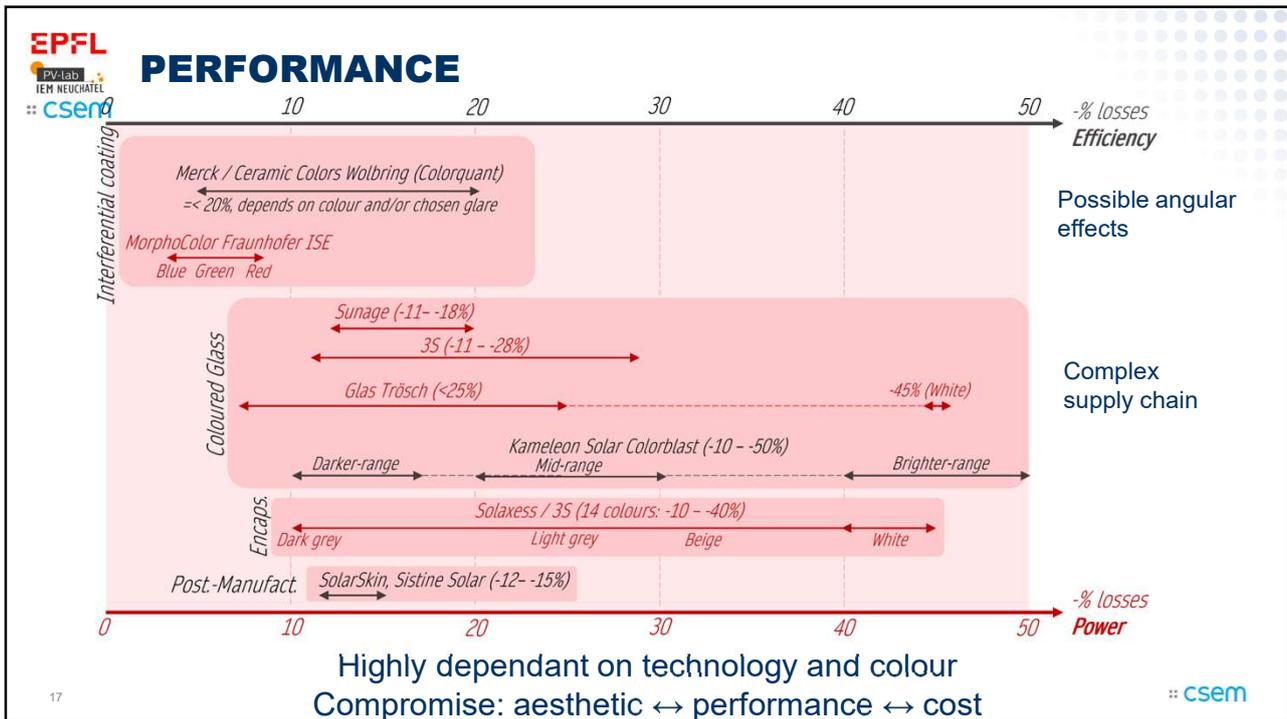
STRONG RELATION TO POLICIES

Is it cost effective?
- Yes it can be!

Is it reducing the carbon footprint ?
- Yes, it is in many cases, even north façades!

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[The carbon intensity of integrated photovoltaics](#) A Virtuani, Joule 7 (11), 2511-2536 (2024)



CHALLENGES WITH THE COATINGS/MATERIALS USED

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Degradation

Before After exposure Before

Thorough testing of each coating/pigments/materials used for all the diversity of tests, in conjunction with changing cell technologies and interconnects schemes

Color reproducibility

Sample ID	Colorimeter	Spectrometer	LAI colorimeter
Ivory 0 mm	[Color swatch]	[Color swatch]	[Color swatch]
Ivory 3.2 mm	[Color swatch]	[Color swatch]	[Color swatch]
Ivory 6.4 mm	[Color swatch]	[Color swatch]	[Color swatch]

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RELIABILITY TESTING + IMPROVING

Example of **CSEM Platform** with extrusion line for custom polymer, module manufacturing and heavy testing infrastructure for modules and colored modules



Reliability challenges should be taken seriously !

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COLOURING TECHNIQUES FOR PV: CONCLUSION

- Revolution in transformative Photovoltaics in the last 10 years
- Replacing inactive construction elements by active elements
- Multiple solutions, products and companies active - each approach has pro and cons
- A chance for keeping niche markets activities in EU with growth potential



A. Borja Block et al., "Colouring solutions for building integrated photovoltaic modules: A review," Energy and Buildings, vol. 314. Elsevier BV, p. 114253, Jul. 2024. doi: 10.1016/j.enbuild.2024.114253.

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PRC 100 SOLAR

VOM LICHT ANGETRIEBEN

1853

TISSOT
1853
PRC 100
SOLAR

21

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NEW CAS - BIPV

- Certificate of Advanced Studies (CAS) / Modules individuels
- Septembre 2025 à janvier 2026
- Campus UNIL-EPFL, Lausanne
- S'INSCRIRE

PHOTOVOLTAÏQUE INTÉGRÉ AUX BÂTIMENTS (BIPV)

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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra








Bundesamt für Energie BFE
Office fédéral de l'énergie OFEN





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FACING THE CHALLENGES OF OUR TIME



Colouring techniques for PV

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[02] Figure from: HZB Home https://www.helmholtz-berlin.de/projects/baip/bipv_en.html

[03] Building in Zürich, Switzerland, with terracotta foil. 3S Swiss Solar Solutions AG

[04] Test installation of MegaSlate Flair DCP coloured modules in Bern with a varied range of colours. Image courtesy of 3S Swiss Solar Solutions AG.

[05] SUM prototype from Kameleon Solar. (A) Façade. (B) Close-up of the small spaced out DCP hexagons. (C) Full façade. Images provided by Kameleon Solar, Team SUM

[06] A portfolio of Colorquant product samples from Ceramic Colors Wolbring. Image provided by Ceramic Colors Wolbring GmbH

[07] Building in Zürich, Switzerland, with terracotta foil. Images provided 3S Swiss Solar Solutions AG

[08] Freesuns project in Ferlens, Switzerland, with different tones of terra cotta solar tiles. (A) Distant perspective. (B) Near perspective. (C) Close-up view. Images courtesy of Freesuns

[09] Solaxess

[10] Computer Science Building of the University of Belfast with Vanceva coloured foils. (A) Main entrance. (B) Façade. Images courtesy of Vanceva

[11] Project for DEWA R & D from Onyx solar employing see-through coloured a-Si. Image provided by Onyx solar

[12] First building equipped with Kromatix technology at EPFL main campus. Images courtesy of Kromatix™ SA

[13] Iconic BIPV building of the Copenhagen International School with blue green Kromatix glass. Images courtesy of Kromatix™ SA

[14] Morphocolor Fraunhofer ISE

[15] BIPV building made with a Solaxess nanotechnology white film. Image courtesy of Solaxess

[16] LOFSolar

[17] LOFSolar

[18] Murdoch University Greenhouse with ClearVuePV windows. Images courtesy of ClearVuePV

[19] Explanatory schematic - ClearVuePV LSC transparent window. Images courtesy of ClearVuePV

[20] Sistine Solar projects. La Monarch mural and Solar flower at Southeast New Mexico College. Images provided by Sistine Solar

[21] Examples of realizations using coloured PV modules by Comp'az. Images courtesy of Association Comp'az

[22] A. Borja Block et al., "Colouring solutions for building integrated photovoltaic modules: A review," *Energy and Buildings*, vol. 314. Elsevier BV, p. 114253, Jul. 2024. doi: 10.1016/j.enbuild.2024.114253.

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