



ines
INSTITUT NATIONAL
DE L'ENERGIE SOLAIRE

liten
cea tech

HIGH EFFICIENCY PHOTOVOLTAIC CELLS

CEA-Liten's research activities on PV technologies cover the entire value chain, from material to the complete system with a focus on the most promising technologies in terms of efficiency. In 2019, an efficiency of over 24% has been achieved by the CEA-Liten laboratories, located at INES, the French National Institute of Solar Energy. This world-class result has been obtained on industrial equipment available on the market. Further research aims to significantly improve efficiencies towards 25% on silicon cells and even 30% with tandem technologies.

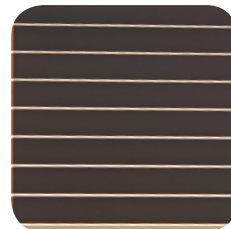
> KEY CEA-Liten REALISATIONS:



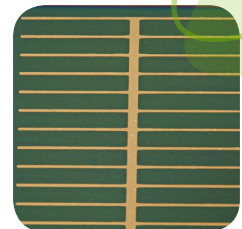
Passivated
contacts bifacial



Bifacial
heterojunction
(SHJ)



Perovskite thin
film



Tandem
perovskite on
silicon SHJ

STATE-OF-THE-ART RESULTS

> Passivated contacts bifacial @ 22.8%

DESCRIPTION

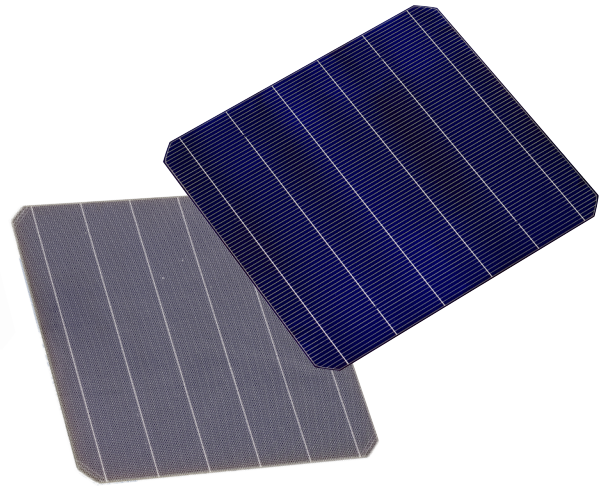
- Passivated contact technology using polycrystalline silicon layers deposited on ultra-thin oxide films
- In the roadmap evolution of existing PERC manufacturer

KEY FIGURES

- **Record Efficiency 22.8%** with industrial processes
- Efficiency potential of 26%
- Compatible with all kinds of silicon wafers (n&p, Cz, cast mono, ...)
- Compatible with multi-junction devices (30% efficiency already obtained)

WHAT'S NEXT?

Integration into multi-junction devices for efficiencies above 30%.



Bifacial heterojunction SHJ @ 24.4% <

DESCRIPTION

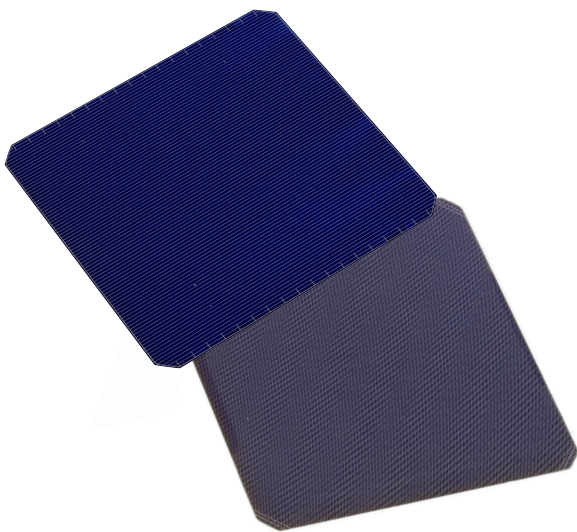
- Silicon heterojunction solar cell (SHJ) based on n-type monocrystalline silicon wafer and amorphous silicon with busbar or busbarless metallization
- A good solution for newcomers or new facilities in the production of photovoltaic cells

KEY FIGURES

- **Record Efficiency 24.4%** in production
- >90% of bifaciality without front efficiency loss
- Stable efficiency down to 100µm wafer thickness

WHAT'S NEXT?

Silicon heterojunction cells with efficiency 25%-26% and low carbon footprint and positive life cycle compatible with tandem integration to reach >30%



> Perovskite thin film @ 20.3%

DESCRIPTION

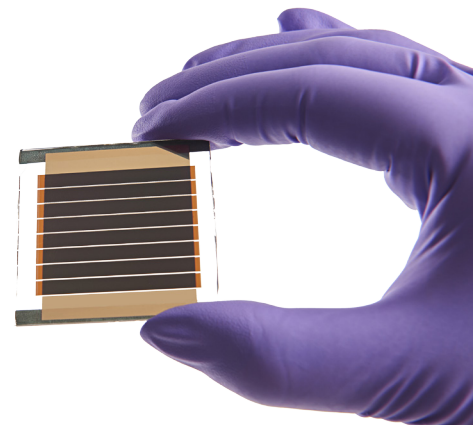
- Thin film Photovoltaic module based on Perovskite materials
- Disruptive technology for Photovoltaic cells manufacturer

KEY FIGURES

- **Record Efficiency 20.3%** / Active area 10 cm² / Geometrical Fill Factor > 93%
- Performances >16.5 µW/cm² @ 200 Lux (low light illumination for indoor application)
- Low temperature process & Low carbon footprint, lightweight, conformability

WHAT'S NEXT?

Larger area (>240cm²) thin film perovskite modules with high performances > 20%



Tandem perovskite on silicon SHJ @ 20.17% <

DESCRIPTION

- Photovoltaic cell in 2-terminal architecture based on perovskite and silicon heterojunction technologies
- Disruptive technology compatible with existing SHJ manufacturer

KEY FIGURES

- **Record Efficiency 20.17%** (without any shading, metallization to be optimized) / Active area 9cm²
- Open circuit voltage 1.8 V

WHAT'S NEXT?

Perovskite on silicon architecture should led to premium PV cells with very high efficiencies >30%

