S'TILE
A new concept for solar cells

ISC International Solar Energy Research Center Konstanz

31st EU PVSEC, 2016 München

A low current high efficiency solar cell composed of a 80µm-thin monocrystalline silicon foil transferred on a low cost substrate

Guocai SUN [1](*), Eden TERRAZ [1], Youssouf BOYE [1], Yves SALINESI [1], Alioune SOW [1], Antoine MALINGE [1], Jayaprasad ARUMUGHAN [2], Alain STRABONI [1]
[1] S'Tile, Pôle des Éco-Industries, 3 rue Raoul Follereau, 86000 Poitiers, France
[2] International Solar Energy Research Center – ISC Konstanz, Rudolf-Diesel Str.15, D-78467 Konstanz, Germany
(*) Corresponding author: Tel: +33 5 79 79 60 18, email: guocai.sun@silicontile.fr

Motivation

- **Reducing the cost of the cell by saving precious materials**
- **Increasing the power of modules with the i-Cell concept**

Structure

Figure 1: An integrated sintered substrate, the conductive zones (in clear) are separated by insulating areas (in dark)

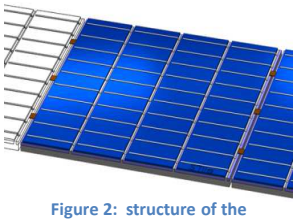


Figure 2: structure of the Integrated solar cell

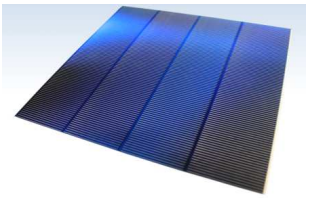
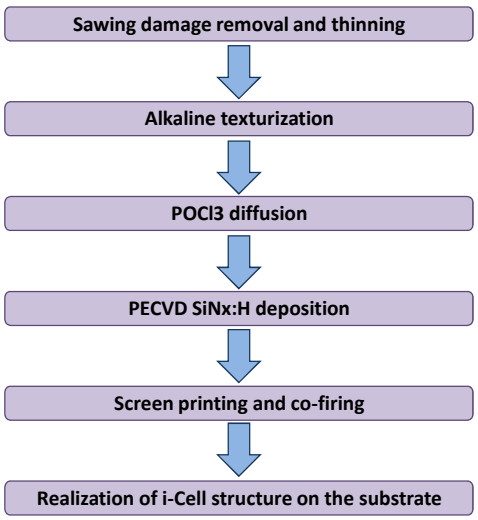


Figure 3: Integrated solar cell: The i-Cell

- Conventional solar cell process used
- 4 sub-cells are connected in series on insulating sintered substrates
- Conductive zones: rear side electrical contact of each sub-cell
- Low-cost insulating sintered substrates produced from silicon powder
- Conductive material incorporated in the initial insulating sintered substrate to obtain the ISS
- The ISS used as a mechanical support and as the rear electrode of the integrated cell
- Possibility of making large area integrated sintered substrates
- 470*470 mm² is doable

Fabrication process



Performance and Results

- Realization of i-Cells on 156*156 mm² sintered substrate
- 4 sub-cells of 39*156 mm²
- Current of an i-Cell is equivalent to the current of one sub-cell
- Total voltage is the sum of the voltages of the sub-cells
- Efficiency of the i-Cell > average efficiency of the sub-cells

Table 1 : characteristics of 1 i-Cell and the corresponding sub-cells

	J_{sc} (mA/cm²)	I_{sc} (A)	V_{oc} (V)	I_{mpp} (A)	V_{mpp} (V)	P_m (W)	FF (%)	η (%)
i-Cell	36.97	2.31	2.486	2.16	2.010	4.34	75.59	18.30
Subcell-1	36.97	2.31	0.626	2.16	0.509	1.10	75.37	17.92
Subcell-2	37.07	2.49	0.626	2.29	0.483	1.11	70.96	16.95
Subcell-3	36.94	2.48	0.623	2.27	0.512	1.16	75.26	17.82
Subcell-4	36.94	2.48	0.624	2.28	0.513	1.17	75.62	17.92

i-Cell structure allows a gain in efficiency of 3.7% relative over classic solar cells, by reducing resistive losses

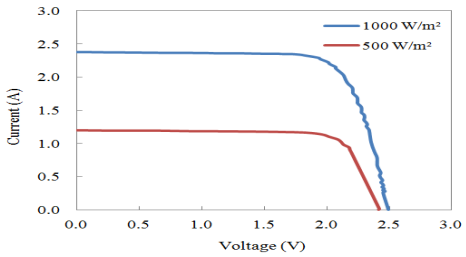


Figure 4: I(V) of the i-Cell under illumination

- Realization of modules prototypes with 6 i-Cells
- Power of 6 i-Cells (27.8W) < power of the module (29.35W)
- i-Cell to module power gain of 5.6%

Table 2: Electrical characteristics of one module with the 6 corresponding i-Cells

	I_{sc} (A)	V_{oc} (V)	I_{mpp} (A)	V_{mpp} (V)	P_m (W)	FF (%)	η (%)
Module	2.39	16.0	2.06	14.07	29.35	76.7	20.10
i-Cell 1	2.47	2.52	2.29	2.06	4.70	75.42	19.31
i-Cell 2	2.46	2.52	2.32	2.03	4.70	75.74	19.31
i-Cell 3	2.44	2.52	2.39	1.95	4.61	74.96	18.94
i-Cell 4	2.49	2.52	2.37	1.95	4.61	73.65	18.94
i-Cell 5	2.43	2.52	2.35	1.96	4.60	75.12	18.90
i-Cell 6	2.49	2.53	2.26	2.02	4.58	72.73	18.79

Summary

- Efficiency higher than 18% obtained using simple solar cells processing
- Unique feature of delivering a voltage x 4 higher and a current x4 lower compared to the classical solar cells
- Large area, for example 156 x 470 mm², low current i-Cell will be more interesting and feasible with our technology
- The number of sub-cells on one i-Cell can be easily modified, making it possible to produce i-Cells with different currents and voltages
- Strong industrial potential for the i-Cell Technology