SmartWire Solar Cell Interconnection Technology

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The SmartWire Contacting Technology (SWCT) is an innovative interconnection technology for crystalline silicon solar cells: standard busbars and ribbons are replaced by copper wires coated with a thin low melting point alloy layer and supported by a polymer foil. It was started by Day4 Energy, in Canada, and is now developed and industrialized by Meyer Burger. SmartWire provides key advantages like, increase in efficiency, cell contacting at low temperature, reduced consumption of silver, enhancement of module reliability and improved aesthetics (as more described below). Today Meyer Burger propose fully automatized SmartWire module line with 90 MWp capacity.

This work presents the last achievement of the SmartWire Contacting Technology and the new results for low silver screen printing and indium-free coating.

SmartWire provides key advantages like:

1. Increase in efficiency by lowering ohmic losses and improved light management (reflection on the wire)
2. Low temperature contacting during module lamination (less thermo-mechanical stresses)
3. Reduced consumption of silver by 85 % or more (see below: Low silver screen-printing part) [2]
4. Enhancement of module reliability (1000 to 2000 electrical contact points on each cell) [1]
5. Improved aesthetics

The typical SmartWire structure based on indium-tin coating is composed of: (1) Cu wire, (2) Cu2(In,Sn) (3) Cu2In3Sn, (4) remaining solder alloys (5) finally the cell metallization. For Ag front metallization, metallurgical bonding is evidenced with In diffusion in Ag and Ag diffusion in the CuInSn phase, enabling high bonding strength at the coating – metallization interface.

The use of Meyer Burger’s SmartWire Connection Technology (SWCT) change the need in the finger line resistance by increasing the number of busbars (nBB) – wires from 3 to > 16. To keep the same power dissipation within the fingers (Pf), the finger line resistance Rf can be multiplied by 36 compared to 3 busbars design (see equation 1), then practically a line resistance up to 10 Ω/mm could be used without change in ohmic losses [2]:

\[ R_f \propto \frac{l_f}{12n_{BB}h} \propto \frac{C_{R_f}}{C_{R_f,12n_{BB}}} \]

where C is the number of busbar (nBB).

Print design with 62 and 77 fingers with screen openings of 30 μm are used to print bifacial cells. With 62 fingers at front and 77 at the back the need only back 25 mg of silver in total. The cost of silver represent only 0.21 €/Wp.

SmartWire advantages

- Increased efficiency by lowering ohmic losses and improved light management (reflection on the wire)
- Low temperature contacting during module lamination (less thermo-mechanical stresses)
- Reduced consumption of silver by 85% or more (see below: Low silver screen-printing part)
- Enhanced module reliability (1000 to 2000 electrical contact points on each cell)
- Improved aesthetics

Indium-free coating

A BiSn alloy coating is developed and tested to replace the InSn coating. Bismuth-In alloys are about 70 times more competitive in costs compared to indium-based alloys. A typical BiSn eutectic coating contains 58 wt% Bi and 42 wt% Sn, it has a melting point of 138 °C, a bulk resistivity twice higher than InSn alloy, and a coefficient of thermal expansion close to pure copper [3].

Low silver screen-printing

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Today SmartWire

Meyer Burger proposes SmartWire GG module line of 90 MWp. This includes the new electrode foil fabrication and SmartWire stringer.

Cost of silver only 0.21 €/Wp

With silver price 445 €/kg (06.10.2014)

Cell assembling using SmartWire connection

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