SOLEMS
L'énergie lumière

Manufacturing process

Solar cells / TD photovoltaic modules / visible light sensors

Short overview of SOLEMS manufacturing process for its thin film silicon devices.

Substrate : Transparent conductive oxide (TCO) on glass
The front electrode is a TCO coating (SnO_2 or ZnO) deposited on glass. It is a very stable transparent conductive oxide that lets the light into the device and collect charges. The TCO thickness is between 100 and 800 nm, and the glass can be 0.5, 1.1, 1.8 or 3.1mm-thick depending on which product is being made (a small cell or a module).

Photosensitive layer : the pin amorphous silicon junction
The thin-film silicon layer is the active part of the device, the photoconductive material devoted to the conversion of the light into electricity. It is produced in a PECVD reactor (Plasma Enhanced Chemical Vapor Deposition) : the gas silane (SiH_4) is cracked in a radiofrequency discharge (13.56MHz), in which Boron and Phosphorous dopants are added via diborane (B_2H_6) and phosphine (PH3) when necessary : to produce the n and p type layers of the pin junction. A precise tuning of deposition temperatures, gas pressure and flow rates, RF power, and coating duration is necessary to obtain good quality of the interfaces, doping efficiency, and reach optimal electronic and optical properties of the device.

Silicon etching
The series connection of individual cells in a solar cell or a module is done by laser scribing. The silicion layer is etched along a straight line by a pulsed laser (double YAG 532nm) to allow the metallic (-) back contact of one cell to be connected to the transparent electrode (+) of the next cell.

Metallic electrodes coating and isolation
The metallic coating placed on top of the silicon junction is made an Aluminium-based film and a Nickel film, both produced by magnetron sputtering. The isolation of neighbor cells is made by a lift-off technique (masking).

Protection & connections
On all SOLEMS devices, an epoxy coating is applied by screen printing to protect the active area, and leave naked the 2 contact (+) and (-) areas. Some tin is deposited on top of these Nickel contacts to make the later soldering of a wire easier. This is the last step (except electrical control) of the manufacturing of SOLAR CELLS and DETECTION CELLS. The TD-type SOLAR MODULES require a weather proof protection (see next paragraph).

Encapsulation
On the edges of the module, all layers are mechanically removed on a width of 3 to 5 mm in order to act as a corrosion barrier. The 2 end-contacts are driven towards the center of the module by thin metallic ribbons. Then an-EVA (Ethyl-Vinyl-Acetate) resin foil and a Tedlar-based plastic backsheet is glued on the back side of the module at 130°C and a 1 atm-pressure. This ensure a good climatic protection; Some cables are then connected through little holes made in the backsheet. This cable connection that has been put away from the edges, to preserve their tightness, receives a final resin protection. After a final control, the module is ready for operation.

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