

# Equipment list

## Production & control

- **Cleaning machine**

Ultrasonic 9-tanks cleaning machine. With hot aqueous detergent baths, 2-axis automatic handling system, a lift-out and air-dryer. To prepare the both glass and TCO – substrates prior to silicon coating.

TCO = Transparent Conductive Oxide

- **Low pressure PECVD reactor**

PECVD = Plasma Enhanced Chemical Vapor Deposition

Equipment for the production of intrinsic and doped thin-film silicon, by a plasma-assisted chemical process starting from gaseous hydride precursors such as silane ( $\text{SiH}_4$ ), see our "Manufacturing process" data sheet. The reactor is equipped with roots and turbo-molecular pumps, 2 RF generators, 9 gas lines, including the plasma etching – gas for the cleaning process.

- **4 micro-etching lasers**

YAG lasers with a wavelength of  $1.064\mu\text{m}$ , pulsed by a Q-switch, are supplying very short pulses for the etching of TCO thin films. Two of these lasers have a frequency doubler to reach the wavelength of  $532\text{nm}$ , to selectively etch silicon films on top of a TCO. An optical fiber is bringing the power on X-Y tables tool, guided by a home made software in order to pattern the solar cells and modules according to the customer's design.

- **2 magnetron sputtering machines (or PVD = Physical Vapor Deposition)**

Machines for reactive and non-reactive DC magnetron sputtering  $13''$ -wide substrates – 3 targets. To produce metallic : Aluminum, Nickel... and oxide coatings : ITO, ZnO ... by reactive sputtering (with  $\text{O}_2$  added). These layers are used as back electrodes of the silicon devices or as transparent electrodes. The processes showing high deposition rate and low temperature ( $< 80^\circ\text{C}$ ) are therefore applicable even to plastic substrate like PET, polycarbonate and polyimide.

- **3 solar modules laminators**

Hot press ( $130^\circ\text{C}$ ) for EVA-encapsulation of solar modules on a back sheet : glass or plastic tedlar-based sheet. Size :  $1 \times 0.5 \text{ m}$  each.

- **1 class A SPIRE solar simulator**

Flash high-precision SPIRE simulator for the current-voltage measurements of photovoltaic modules under  $700$  to  $1000\text{W}/\text{m}^2$  in Standard Test Conditions : AM 1.5,  $25^\circ\text{C}$ .

Module max size :  $1.5\text{m}^2$

- **Current-voltage measurements under low illumination**

Several I-V measurements units on different light sources : fluorescent tubes  $50$ - $1000 \text{ lux}$ , bulbs  $5000$  –  $30\,000 \text{ lux}$ , HMI lamp up to  $80\,000 \text{ lux}$ . To control PV characteristics of indoor cells as well as outdoor modules and light sensors.

- **1 damp heat chamber / several heat chambers**

Dry and humid climatic chambers ( $85^\circ\text{C}$   $85\% \text{ H.R.}$ ) for annealing and reliability tests.

- **Square resistance probe**

4 points measurement units for square resistance control of conductive films.