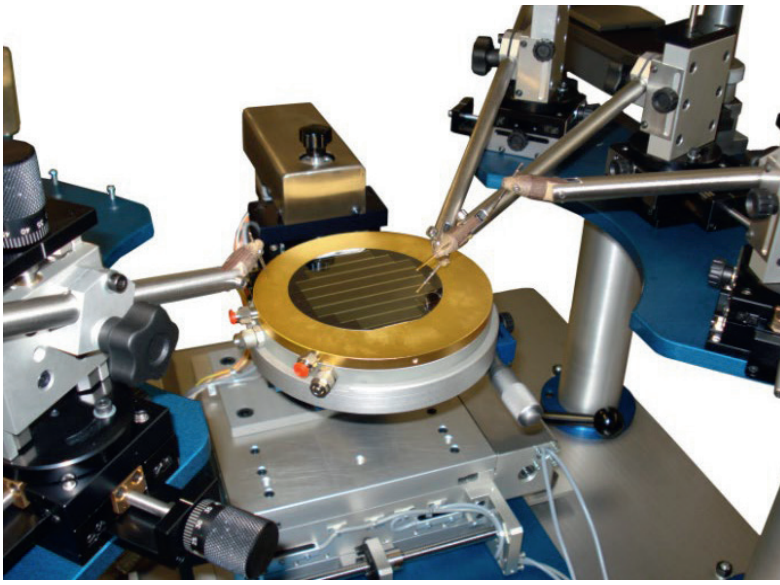
SoCRATes

Solar Cell Reliable Automatic Tester

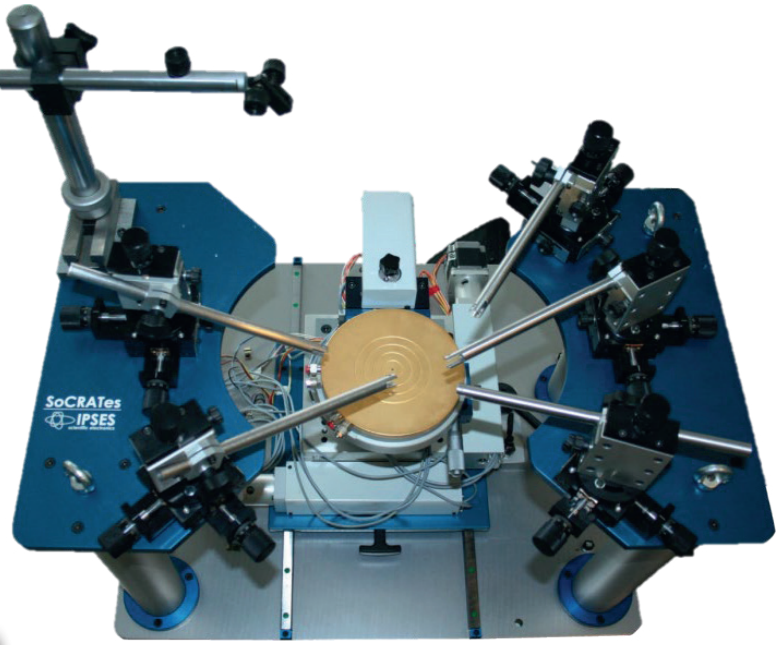
SoCRATes test system for the characterization of the solar cells has been conceived to answer to the need for a fast e precise instrument to verify the correct functionality and to divide in similar classes the solar cells used in the aerospace sector.

The system is able to test and classify the cells contained in wafers of various sizes (up to 4 inches) and to interface with solar simulators controlling the relevant shutter.

IPSES's aim in designing the system was to create a reliable and efficient instrument that minimises operator intervention through automated procedures, thus reducing the risk of error.

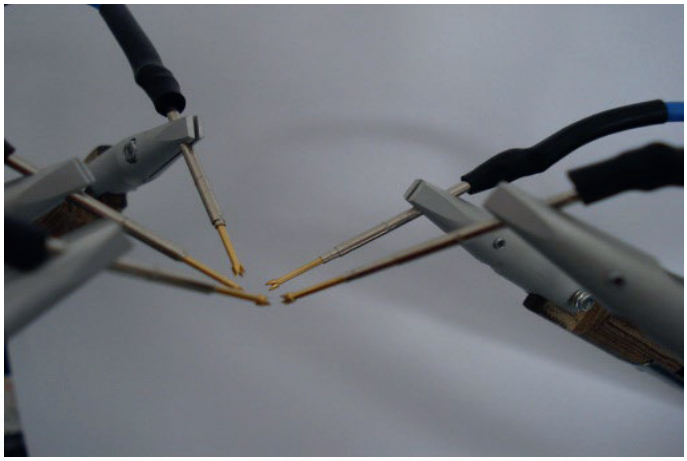


Testing phase of a solar cell wafer



Overview of the system

The device is composed of a **mechanical system with three axes** for the movement of the cells and their contacting through **test needles** placed on a **micrometric adjustment system with three degrees of freedom**, a **control unit** managed by a PC and a fast and intuitive user software developed by **NI LabVIEW**.



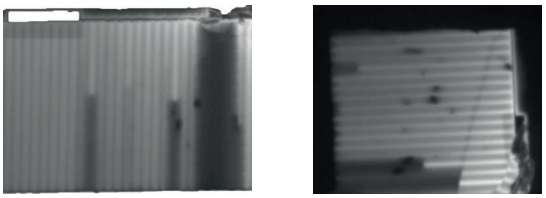
Detail of the contact needles

The solar cells to be tested, still joined together to form a circular **wafer**, are placed on a **thermostated gold plated chuck**. The gold layer allows the optimal electrical and thermal conductivity between the chuck and the wafer substrate of the cells in addition to prevent any oxidation over the years.
A **vacuum system**, integrated in the wafer chuck, ensures the stability of the position of the wafer during the test, while a **system of recirculation of water** allows the stability of the temperature. The temperature is continuously monitored by a **platinum sensor**.

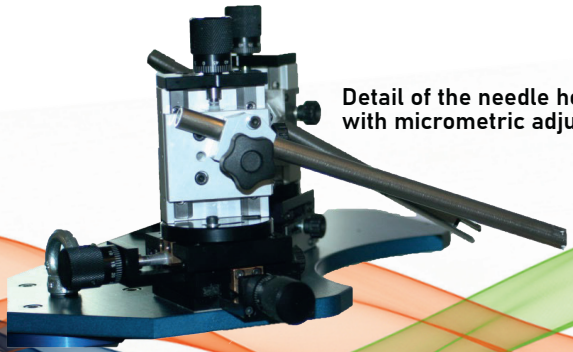
The t**hree-axis system** allows the positioning and the contacting of each cell on the needles so that all **pads** are contacted. An **active load** running on all four Cartesian quadrants allows a complete characterization of the cell by the following tests:

- acquisition of **current-voltage curve** during irradiation, identifying of the maximum power point of the cell, the fill factor, the Isc, the Voc and the load current at a given voltage.
- excitation of the cell to evaluate their **electroluminescent emission**
- characterization of the internal diodes
- measurement of reverse current

The **electroluminescence** is evaluated by a **NIR camera** that captures both the visible spectrum and the near infrared (400 nm to 900 nm).



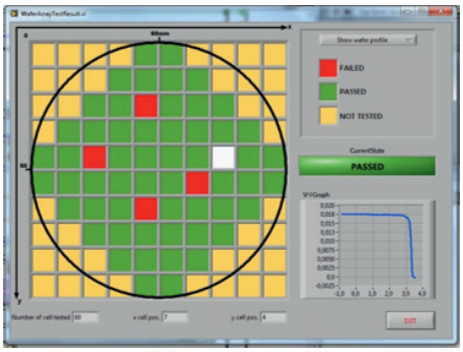
Acquisition of electroluminescence at 850nm: some defects are visible in the cell



Detail of the needle holder with micrometric adjustment

Thermostated wafer chick and NIR camera

The control unit, managed by a PC, provides to generate signals and to operate the motors of the mechanical system.
The **management software**, compatible with **Windows** systems and **developed using NI LabVIEW**, is able to independently manage the characterization of all the cells present on the wafer, to ensure the movement of the target wafer, to control the shutter of the solar simulator, to save the captured images from camera and the test data, exporting them also in CSV format.



Software interface developed in LabVIEW

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