

## Coating Thickness Measurements for Solar Applications

Photovoltaic and solar heat modules convert sunlight into usable energy. The efficiency is optimized by applying thin-film coatings for enhanced absorption on various materials.

The absorption layers feature a special optical design which can be analyzed by spectroscopy. This measurement is described below in respect to the photovoltaic demands. The same measurement technique can be applied for solar-thermal materials.

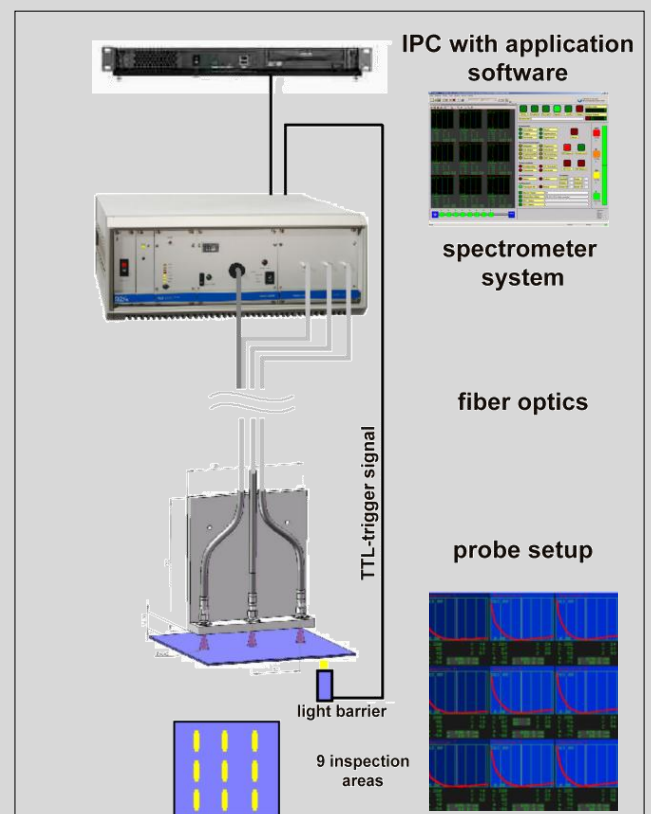
In case of solar cells, the coating thickness of the optical materials and its uniformity has to be monitored. The layer thickness is influencing the efficiency and, in addition, the surface color, defining the appearance.

In close cooperation with one of our customers, one of the largest solar cell manufacturers in the world, an on-line measurement system was integrated into the production line.

### Measurement Principle

Optical spectroscopy allows the simultaneous determination of two quality criteria from one spectrum. From the optical interference pattern within the reflectance spectrum of a solar cell the layer thickness can be calculated. Furthermore, there is also a correlation of the layer thickness and the color.

Three optical measuring probes are mounted in a web over a conveyor belt directly after the deposition process. The solar cells trigger three separate measurements via a light barrier. This results in nine elliptic measurement spots distributed on the solar cells. The nine spots provide precise information about the layer thickness, uniformity and alert early in case of mayor defects. This allows a fast reaction on changing product quality during the production.



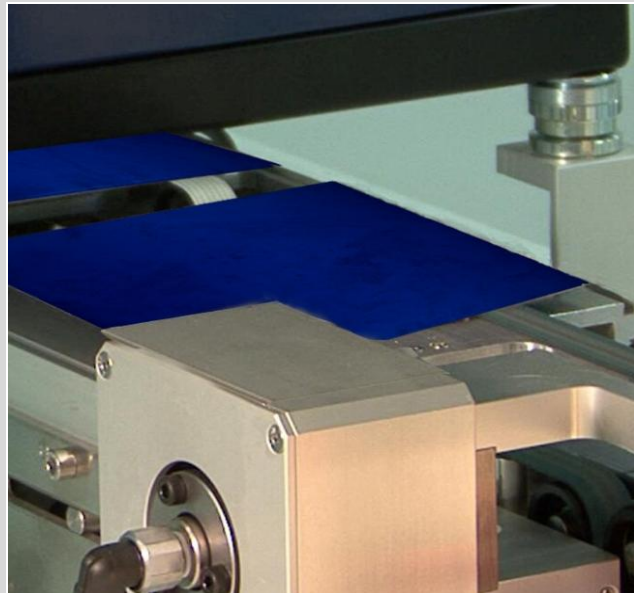
## Application Notes – MultiSpec System Vol. 39

### Measurement System.

The diode array based MultiSpec spectrometer systems of **tec5** offer high sensitivity and an optimum signal to noise ratio. Their flexible triggering options are allowing synchronization with production processes. The spectra can be recorded and analyzed in milliseconds and, therefore, the spectrometer systems are ideally suited for in-line process control. The flexible light guide technology provides measuring probes for small installation spaces.

The MultiSpec Pro software offers the algorithms to calculate the layer thickness and the color values simultaneously. Various process communication interfaces, like Profibus or OPC, are available.

Alternatively, there is a special software interface from VITRONIC for the tec5 hardware which complies with the SECS/GEM standard and offers a turnkey solution for solar industry.



### Your Partner in Spectroscopy



Since 1993 **tec5 AG** has been developing fiber-optic spectrometer systems based on diode array technology. Today, tec5 is operating worldwide with subsidiaries in the USA and UK and global representatives are positioned to better serve the market.

At tec5 we pair our core competencies in high speed diode array readout technology, optical, mechanical, electronic and software engineering with excellent customer support. Our high quality products range from standard OEM electronics modules to complete application specific solutions. In close cooperation with our customers, a multitude of applications have been successfully implemented in different industries.

We are proud to be at the frontend in the field of spectroscopy and to provide cutting edge technology – today and in future.



**tec5 USA Inc.**  
80 Skyline Drive  
Plainview, NY 11803  
Tel: +1 516-653-2000  
Fax: +1 516-939-0555  
info@tec5usa.com • www.tec5usa.com



**tec5 AG**  
In der Au 27  
61440 Oberursel, Germany  
Tel: +49 6171 9758-0  
Fax: +49 6171 9758-50  
info@tec5.com • www.tec5.com