

# Flames

## Control of all layers in the thin-film solar cell manufacturing process

The LayTec Flames IR provides a unique approach to monitoring thin-film PV processes which greatly improves traditional off-line and batch sampling methods. The Flames IR is an in-line system which is capable of measuring the properties and thickness of all layers – transparent conducting oxide (TCO), absorber and buffer layers – throughout the solar cell manufacturing process.

Thin-film PV producers have realized a lot of benefits through the ability to control their production on-line.

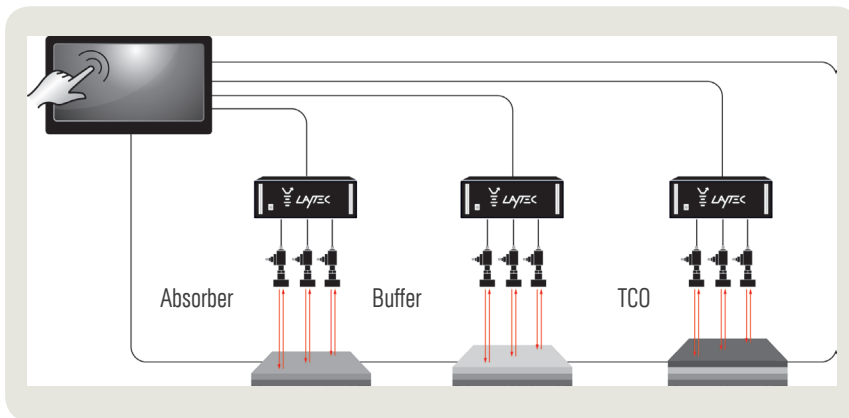


Production anomalies are quickly identified and corrected, development cycles are accelerated, transfer and ramp up of established processes to new lines are facilitated and conditions are easily re-established after maintenance. This all adds up to greater yields and reduced costs – the most important factor in today's PV cell production!

The Flames IR monitoring system is based on specular spectroscopic reflectance measurements. It is designed for a perfect in-line control of all thin-film PV processes. Flames IR is available in various editions for copper indium gallium selenide (CIGS), cadmium telluride (CdTe), amorphous microcrystalline Si and organic material based thin-film solar cells. Set-ups for roll-to-roll applications are available as well.

### Flames IR features

- Adaptable to every in-line process via customized optical heads and mounts
- Spatially resolved thickness measurements through multiple heads
- Fast data acquisition for in-line measurements on moving substrates automated film thickness analysis (incl. algorithms for rough layers and LayTec dispersion database for all PV materials)
- PV-line software integration via Profibus, Ethernet, TCP / IP or other protocols for automated operation



Flames IR ensures precise homogeneity control through multiple heads in-line!

Flames IR can be adapted to virtually any PV thin-film deposition system. It is designed to be integrated into typical in-line and roll-to-roll processes and applicable to all major types of substrates and PV cell designs.

## System setup

Reflectance measurements after each deposition step are mandatory for a precise thickness determination of thin layers on rough materials. The position and number of interference fringes measured are automatically analyzed and fitted to determine the film thickness on-line.

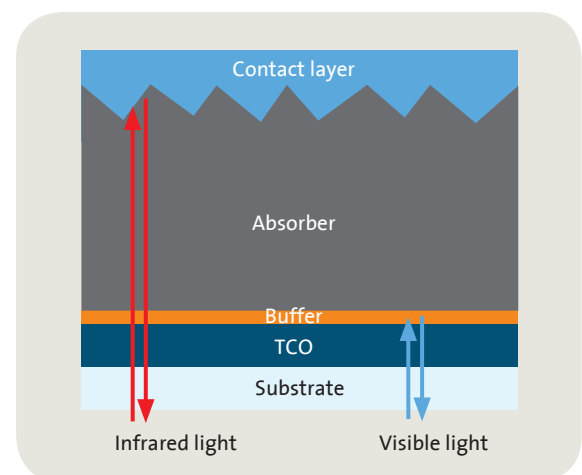
While the TCO and CdS film thicknesses are detected with a spectrometer operating in the visible to near infrared spectral range (500 – 1000 nm), a determination of the film thickness of the absorber layer requires an infrared reflectance measurement, as these materials are designed to completely absorb visible light.

The thickness measurement accuracy is typically 1 – 2 %. LayTec's expertise on fitting optical data and deriving accurate optical properties (n and k values) of the layers in a multi-layer process is applied for the most precise automated thickness analysis available for thin-film PV today!

## Measurement capability

Flames IR provides in-line access to key parameters of each layer:

- Film thickness
- Homogeneity
- Effective absorption
- Conductivity fingerprints
- Interdiffusion effects
- Roughness and texture information
- Visible light provides information on the buffer and TCO layers
- Infrared light probes the whole stack
- Measurement after each deposition step is performed to obtain the precise film thickness of each layer



Specifications are subject to further technical development.

Developed, manufactured, qualified in Germany.

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