Optical in-line monitoring of deposited layers in large area coating lines

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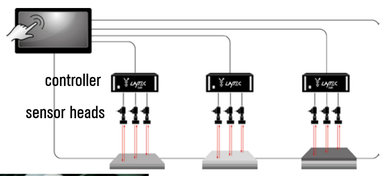
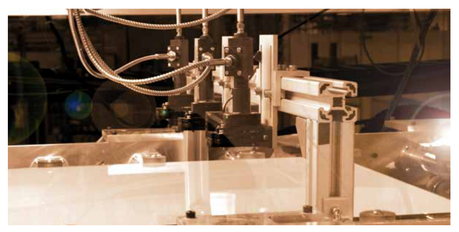
Knowledge is key

Optical monitoring system (LayTec Flames)

In-line monitoring systems measure reflectance and/or transmittance on coated glass panels while the panels are transported by a conveyor system in a production line. Features:

- Compact optical sensor heads and trigger sensors mounted on cross beams in a production line
- Controller unit with halogen light source, spectrometers and reflectance standard supporting up to 7 sensor heads
- Controller equipped with programmable logic controller (PLC) for data analysis and communication with external manufacturing execution system (MES)
- Units can be combined for monitoring in consecutive multi-layer deposition lines
- Up to 100 spectra per second from each sensor head



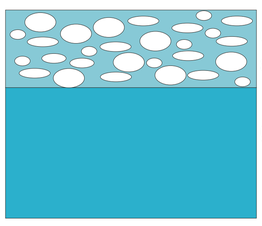


Application I: Antireflection coating on solar glass

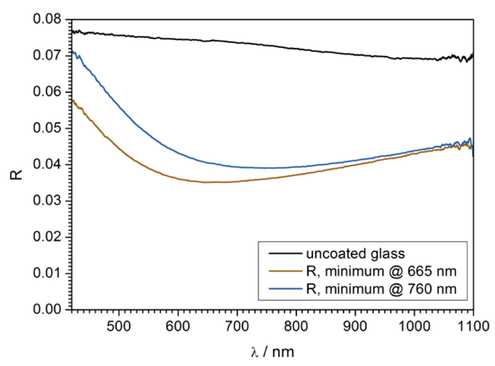
Purpose: Antireflection coating for solar glass

Process: Liquid precursor solution is deposited on glass. After drying and thermal curing, a coating of hollow silica particles is obtained.

Challenges: Minimum of reflectance must match the solar cell efficiency maximum. Optical appearance of the coating must be homogenious for aesthetic reasons.

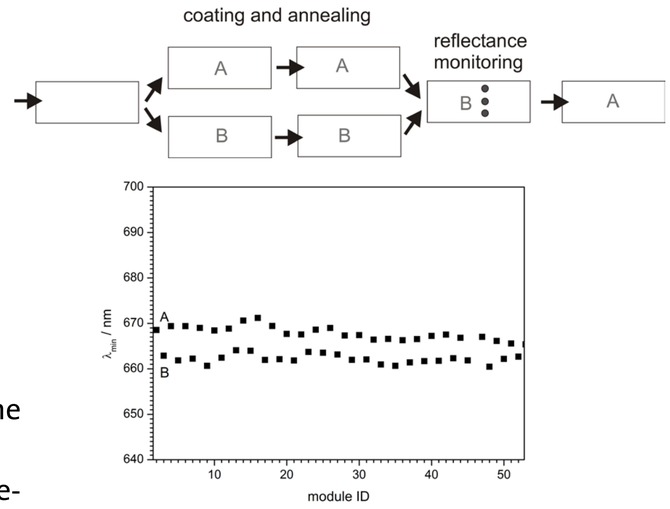


In-line reflectance spectra:



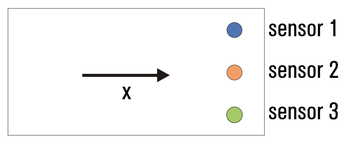
- Spectra directly reveal the location of the reflectance minimum.
- Inhomogeneities in the coating are revealed by shift of minimum position and intensity.

Coating is applied in two chambers (A and B). The feeds are joined before the monitoring position.

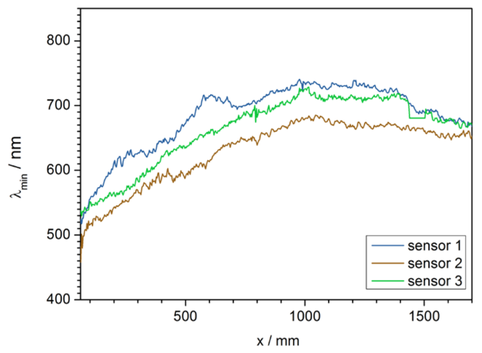


- Systematic differences between the two chambers (A and B)
- Deviations in each chamber

Measurements on three traces on moved glass pane:



Homogeneity of coating is monitored with a lateral resolution of up to 3 mm.

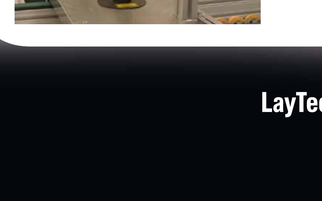


Application II: Coating for TFT displays

Purpose: Production of TFT displays

Process: Three layers are applied by CVD process.

Challenges: Three layer thicknesses must be determined simultaneously. Narrow process window requires accuracy better than 1 nm.

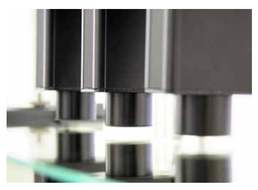


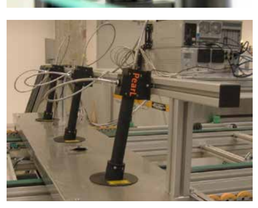
Fitting of optical model to in-line spectra gives thickness of all three layers.

Thickness profiles on moving sheet are obtained with an accuracy better than 0.5 nm per layer.

Continual measurements reveal run-to-run deviations.

Complementary methods





Optical in-line monitoring can be readily combined with:

- Eddy current measurements for in-line monitoring of sheet resistance
- Photoluminescence measurements for in-line monitoring of layer composition

Conclusions

In-line reflectance measurements allow:

- Monitoring of optical properties
- Monitoring of layer thicknesses
- Measuring multiple layer thicknesses with a resolution better than 0.5 nm
- Homogeneity mapping of substrates
- Tracking of deviations in the production
- Feed-back of data in production MES

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