APP NOTE

Display Thin Film Measurement Applications

Accurate display technology measurement is essential for developing high-performance displays with exceptional brightness, color accuracy, transparency, and long-term reliability. Thin conductive, optical, and protective films directly influence display performance across OLED, LCD, MicroLED, and other advanced display technologies.

StellarNet's display technology measurement systems combine reflectance and transmission spectroscopy with modular optical measurement platforms to characterize display coatings, transparent conductive films, OLED materials, LCD components, and emerging MicroLED technologies through fast, accurate, non-contact optical measurements.

Common Display Thin Films

StellarNet solutions support thickness measurements for:

- Transparent Conductive Oxides (ITO) – Touchscreens & Transparent Electrodes
- OLED Thin Films – Organic Emissive & Transport Layers
- Polarizers – Contrast & Light Polarization
- Color Filters – RGB Pixel Color Generation
- Anti-Reflective (AR) Coatings – Improved Display Visibility

Key Display Measurement Objectives

- Brightness & Contrast – Optimize display performance and viewing quality.
- Color Accuracy – Verify color consistency across display technologies.
- Touchscreen Performance – Characterize conductive and functional coating layers.
- Manufacturing Consistency – Improve process control and coating uniformity.

By evaluating critical film and coating properties, display manufacturers can verify optical performance, improve production quality, and ensure reliable devices across LCD, OLED, and MicroLED technologies.

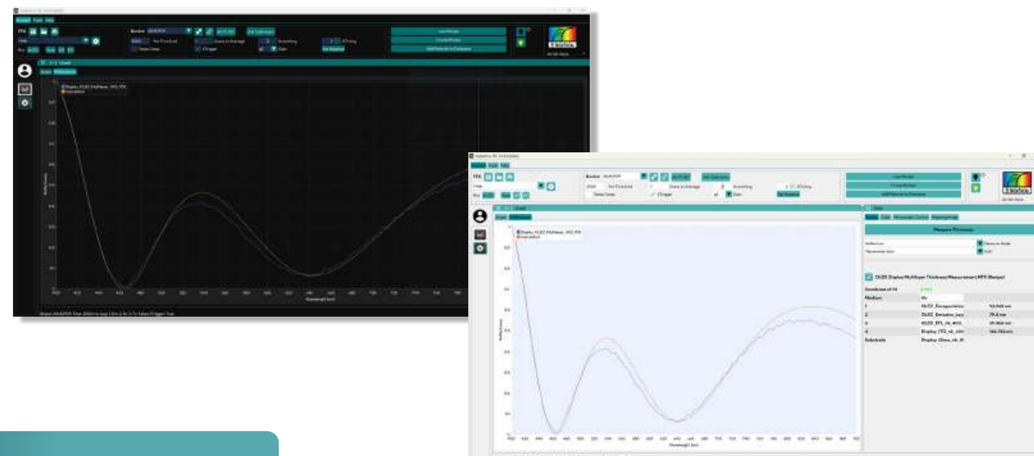
APP #1

OLED Display Multilayer Thickness

OLED displays consist of multiple ultra-thin organic functional layers deposited between transparent conductive electrodes. The thickness of the encapsulation layer, emissive layer, electron transport layer (ETL), and transparent electrode directly influences light output, color uniformity, efficiency, and device lifetime. Spectroscopic reflectometry combined with Transfer Matrix Method (TMM) analysis enables accurate, nondestructive measurement of these multilayer structures, supporting OLED display research, process development, and production quality assurance

Typical Recipe:

- Air
- Organic Encapsulation (100 nm)
- Organic Emissive Layer (80 nm)
- Electron Transport Layer (40 nm)
- ITO (140 nm)
- Display Glass (Bulk)



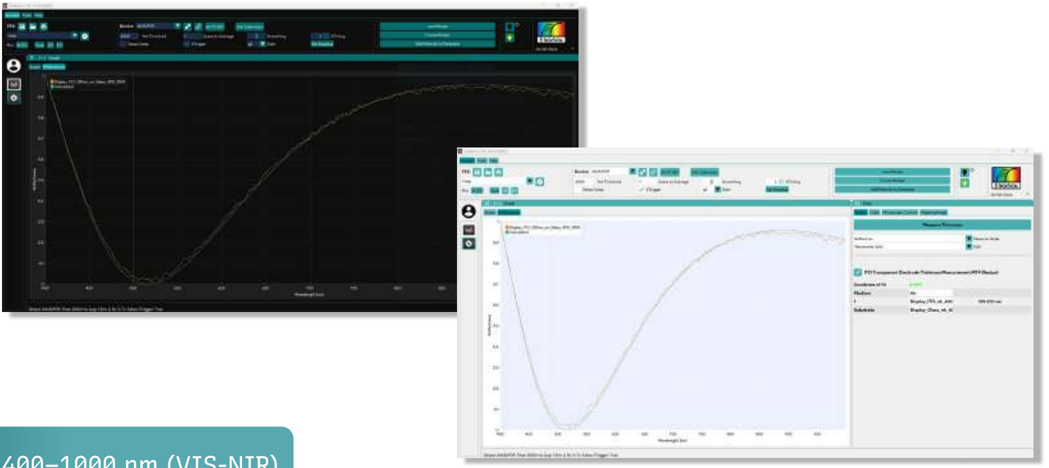
Recommended Spectrometer: 350-900 nm (UV-VIS)

Why it's Important: The thickness of each OLED layer directly influences brightness, color accuracy, power efficiency, and device lifetime. Optical thin-film metrology helps manufacturers verify multilayer deposition, reduce process variation, and produce consistent, high-performance displays.

APP #2

ITO Transparent Electrode Thickness

Indium Tin Oxide (ITO) is the industry-standard transparent conductive coating used in LCD, OLED, touchscreen, MiniLED, and MicroLED display manufacturing. The ITO layer must provide excellent optical transparency while maintaining low electrical resistance for efficient pixel operation and touch sensing. Precise thickness control is essential for achieving uniform brightness, color accuracy, conductivity, and display performance. Spectroscopic reflectometry provides rapid, non-contact measurement of ITO coatings on glass or polymer substrates, enabling process optimization and high-volume manufacturing quality control.



Typical Recipe:

- Air
- ITO (130 nm)
- Display Glass (Bulk)

Recommended Spectrometer: 400–1000 nm (VIS-NIR)

Why its Important: ITO serves as the transparent electrode in LCD, OLED, and touchscreen displays. Measuring film thickness ensures consistent transparency, sheet resistance, and display performance while supporting high-yield manufacturing.

APP #3

Anti-Reflection (AR) Display Coating Thickness

Anti-reflection (AR) coatings are commonly applied to smartphone displays, tablets, automotive displays, optical windows, camera covers, and AR/VR optics to minimize surface reflections and improve display visibility. Uniform coating thickness is critical for achieving low reflectance, high optical transmission, and excellent image quality under various lighting conditions. Spectroscopic reflectometry provides fast, accurate, and nondestructive measurement of AR coatings during manufacturing, ensuring consistent optical performance and product quality.

Typical Recipe:

- Air
- SiO_2 (105 nm)
- Display Glass (Bulk)

Recommended Spectrometer: 350–900 nm (UV-VIS)

Why is it important: Anti-reflective (AR) coatings are widely used on display cover glass, touchscreens, and optical components to reduce reflections and improve image clarity. Optical thin-film metrology provides fast, non-contact measurements of AR coating thickness, supporting process control, coating uniformity, and consistent display performance.

APP #4

Hard Coat Protective Layer Thickness

Hard coat coatings protect display surfaces from scratches, abrasion, chemicals, and environmental wear while maintaining excellent optical clarity. These polymer-based coatings are widely used on smartphones, tablets, industrial touch panels, automotive displays, and consumer electronics. Because hard coat thickness affects durability, optical transmission, and surface performance, accurate thickness measurement is essential during production. Near-infrared spectroscopic reflectometry enables rapid, non-contact measurement of micron-scale protective coatings on glass or polymer substrates with excellent repeatability.

Typical Recipe:

- Air
- UV Hard Coat (5 µm)
- Display Glass (Bulk)

Recommended Spectrometer: 500–1700 nm (VIS-NIR)

Summary: Broad Display Thin Film Measurement Capability

Display manufacturing relies on precise thin film measurement to ensure optical performance, color accuracy, and long-term device reliability. StellarNet spectroscopic reflectometry systems combine UV, VIS, NIR, and UV-VIS-NIR spectrometer configurations with Transfer Matrix Method (TMM) analysis to deliver fast, non-contact thickness measurements across a wide range of display materials.

From transparent conductive oxides and OLED multilayer structures to anti-reflection coatings, hard coats, optical films, color filters, polymer coatings, and touch panel coatings, the system supports both research and high-volume production. Its broad spectral coverage enables accurate measurement of nanometer-scale functional films and micron-scale protective coatings for process development, quality control, and advanced display manufacturing.

StellarNet Inc