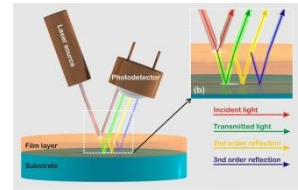


ThetaMetrisis APPLICATION NOTE #050

Fast and accurate measurement of battery separator thickness



Introduction:

Batteries are crucial in the global economy transition of their ability to maintain a balance between supply and demand within the power system. Batteries are made up of an anode, a cathode, and an electrolyte. The separator is a polymeric membrane forming a microporous layer and is placed between battery's anode and cathode to keep the two electrodes apart to prevent electrical short circuits while also allowing the transport of ionic charge carriers. The separator's structure and properties considerably affect the battery performance: e.g. energy, power density, cycle life, and safety.

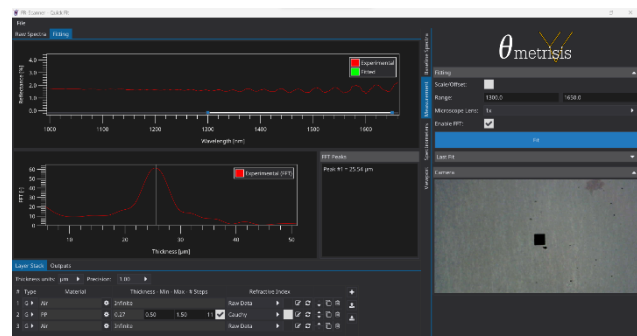
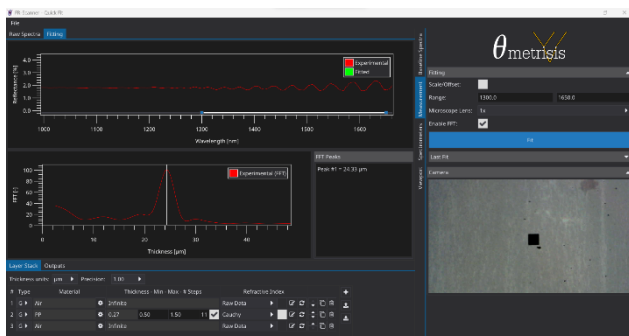
Specific types of polymers are employed as battery separators. Among them, polyethylene (PE), polypropylene (PP), and their blends or film stacks are widely used. Separator thicknesses typically range from 25.4µm to 12µm, depending on the chemical system, without compromising the cell properties. It is of paramount importance that the battery separator thickness is within battery specifications.

Means & Methods:

Sample under characterization was a **Celgard 2500 Monolayer PP battery separator** with 25µm nominal thickness. The separator has a white hazy color that prevents measurements in the VIS spectral range. The characterization was carried out with an **FR-pRo NIR**, operating in the **900nm-1700nm spectral range**, and equipped with **FR-Mic and a 5X long working distance objective lens**, capable to deliver a spot size of 50µm. By employing the particular set-up and the XY-stage of the measurement tool, accurate thickness measurement of the battery separator is performed at various points on the foil.

Results:

In images below, typical recorded experimental reflectance (red line), as seen on the FR-Scanner software, is illustrated. The measurement of battery separator thickness is done through the FFT spectra, (graph below the reflectance spectrum) with the FFT peak associated with the thickness of the battery separator. The FFT spectra are broad, a clear indication of the thickness variation and roughness over the probed area.



Battery separator thickness at different points

Conclusions:

Commercially available Li Ion Battery separator foils (poly(propylene)) were characterized in terms of thickness. The evaluation was carried out by an FR-pRo NIR coupled with FR-Mic and 5X objective lens.