SPECTRE - APPLICATION NOTE

Characterization Of Plastic Films

Advantages of using SPECTRE

- Broad Spectral Coverage (0.8 - 4.2 μm)
- High Resolution (down to 3 nm)
- Fast Measurements (less than 1 second)
- High sensitivity, no focusing required
- Suitable also for incoherent light sources

SPECTRE is a compact ultra-broadband spectrometer, which enables one to distinguish different types of plastics and evaluate their thickness by measuring transmittance spectra from NIR-IR to MID-IR spectral region.

EXPERIMENTAL SETUP

In Figure 1 the experimental setup for plastic films characterization is shown. The employed light source is a common 50 W halogen lamp, connected to a stabilized power supply. The emission spectrum of the lamp is similar to a blackbody radiation with T=3000 K. The light emitted by the lamp illuminates the sample, which is placed at 1 meter from the lamp. The light transmitted by the sample is then sent to the SPECTRE in free space propagation, without the need of any lens nor optical fiber. In 1 second measurement time, the spectrometer measures the spectrum of the light transmitted by the sample. The SPECTRE is connected via USB to a laptop, where the software provides data analysis and visualization.

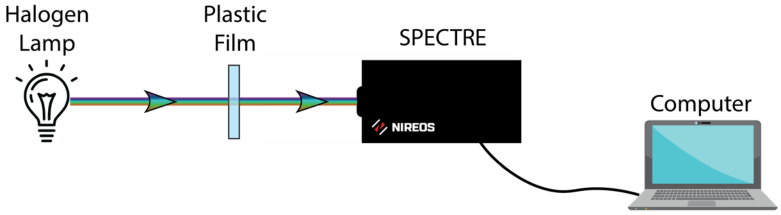

FIGURE 1*: Experimental setup for measuring transmittance spectra of plastic films.*

MEASUREMENT PROCEDURE

In order to measure the absolute transmittance of samples, a measurement of the background spectrum (that is, the spectrum of the light source, without the sample) is required first. This background spectrum is measured only once at the beginning of the measurement session and stored in memory, since both the lamp and the SPECTRE are extremely stable also during a long-term use. After that, the plastic films can be placed between the lamp and the SPECTRE, which measures the spectrum of the light transmitted by the sample. In the presented measurements, the transmittance spectrum of the sample is calculated in the following way:

$$\text{Transmittance}\ (\lambda) = \frac{\text{Light transmitted by the sample}\ (\lambda)}{\text{Background spectrum}\ (\lambda)}$$

RESULTS

Figure 2 shows the transmittance spectra of two different kind of plastic films of approx. 10 micron thickness: a composite of polyolefin and nylon (black curve) and a simple polyolefin (red curve). One can clearly identify the two different plastic films by looking at the strong absorption band in the 3 - 3.5 μm spectral region: while the red curve shows only one strong absorption peak centered at approx. 3.5 μm (associated to polyolefin), the black curve shows also the contribution of nylon, characterized by the absorption peak at approx 3 μm.

Figure 3 reports the transmittance spectra of two plastic films (both composites of polyolefin and nylon) with different thicknesses: the red curve corresponds to a 1-layer film (approx. 10 μm thickness), while the black curve corresponds to a 2-layers film (approx. 20 μm thickness). All these measurements are obtained within 1 second measurement time.

The broad spectral coverage in the NIR-MIR band and the high sensitivity make SPECTRE the ideal device for plastic films characterization. Thickness measurements and real-time monitoring can be performed during the production phase of plastic films, allowing high reproducibility of the manufacturing process as well as reducing waste of material.

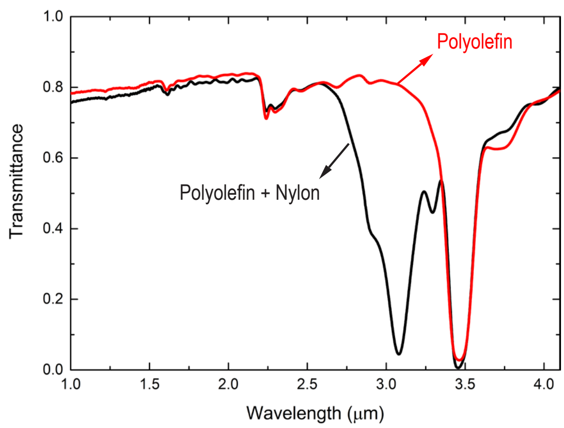

***FIGURE 2**: Transmittance spectra of two different types of plastic films.*

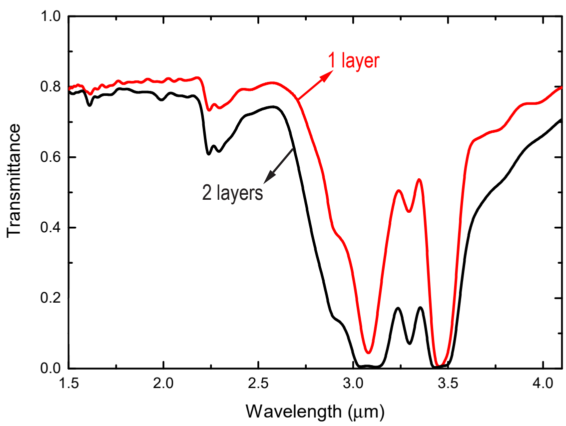

***FIGURE 3**: Transmittance spectra of two plastic films with same composition, but different thicknesses.*

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