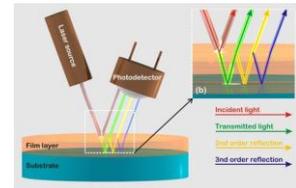


ThetaMetrisis APPLICATION NOTE #010

Real-time monitoring of film thickness changes due to environmental changes by WLRS



Goal: Real-time monitoring of film thickness changes of polymer film due to interaction with the environment (sorption/desorption of analyte's molecules).

Means & Methods: FR-Basic is combined with a Gas Chamber, fig. 1, for the accurate real time monitoring of film thickness changes due to sorption of analytes from the environment. All measurements were performed with an FR-Basic VIS/NIR tuned to operate in the 400-1000nm spectral regime while the sample was placed into the gas chamber and the reflection probe was mounted at a short distance outside the gas chamber. For the delivery of the analytes of interest a computer controlled set-up with mass flow controllers, bubblers and valves in an environmental chamber for constant temperature was employed.

Results: The sample is Si wafer coated with PHEMA layer applied with spin coating. PHEMA is a well-known hydrophilic methacrylic polymer with fast reversible operation upon the sorption of water molecules. In figs. 2a, b the fitting of the reflectance spectrum at two conditions, 0%RH and 40%RH are illustrated. Clearly the fitting is very good. Thanks to the accurate and very fast fitting algorithms implemented in FR-Monitor, the layer thickness can be monitored in real-time while the experimental spectral response can be stored in the computer for later off-line post processing.

In fig. 3 two screen-shots from the real-time monitoring of PHEMA thickness in the 0%-20%-40%-60%-0%RH sequence are shown. Clearly the experimental spectral data acquisition and fitting with WLRS are fast enough to follow the dynamics of sorption and desorption of the analyte (water) and the parameters governing the swelling/de-swelling processes can be calculated.

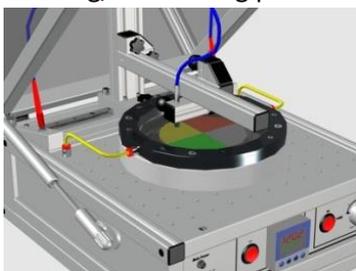


Figure 1: Fitting at nitrogen atmosphere.

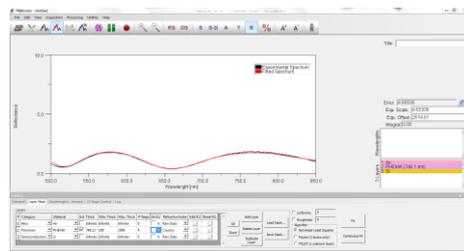


Figure 2a: Fitting at nitrogen atmosphere.

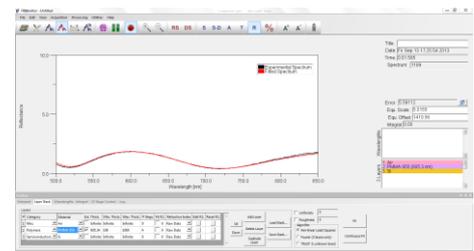


Figure 2b: Fitting at 40% relative humidity atmosphere.

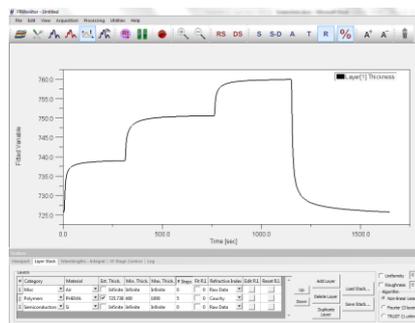
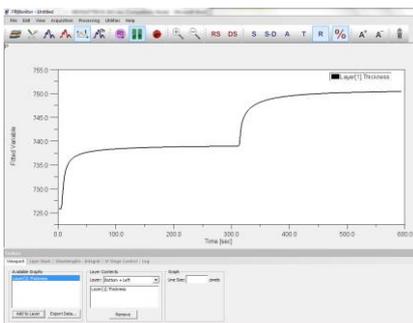


Figure 3: Real-time monitoring of PHEMA thickness due to the sorption / desorption of water molecules. At the left hand side the 0%RH, 20%, 40% are illustrated while at the right hand image the 0%-20%-40%-60%-0%RH sequence is monitored.

Conclusions: FR-Basic is capable to accurately monitor fast film thickness changes such as sorption/desorption of water molecules in a hydrophilic polymer.