analytikjena

Application Note UV VIS

Fields of Application / Industry:

- Chemistry / Polymer Industry
- Clinical Chemistry / Medicine / Hygiene / Health Care
- Cosmetics
- Electronics
- Energy
- Environment / Water / Waste
- Food / Agriculture
- Geology / Mining
- Material Analysis
- Metallurgy / Galvanization
- Pharmacy
- Refineries / Petrochemistry
- Semi-Conductor Technology
- Others

紫外可见光谱测量膜的厚度和透过率

摘要：

可变角度反射附件是紫外可见分光光度计扩展其应用领域的重要附件之一，可用于测量路径长度和固体样品的折射率。在定义波长下，通过测量样品不同角度下的反射率，利用特殊数据处理手段获取薄膜/涂层厚度指标。这方面的应用在多种行业逐步普及，例如太阳能光伏，电子元器件，光电元件，显示屏幕等行业都涉及到将半导体沉积到元件表面，沉积速率的的变化薄膜厚度不同，对元件特性产生很大影响，因此，测定薄膜/涂层厚度非常重要。

本文利用德国耶拿公司 SPECORD 250 Plus 紫外可见分光光度计和可变角度反射附件。SPECORD 250 Plus 在单色器前有一个散列光栅，可以明显降低散射光，一方面可以预分解光，另一方面可提高透射和反射测量的灵敏度。利用可变角度反射附件，通过灵活调节不同的测量角度的反射率，使用德国耶拿公司提供的特殊软件工具直接计算不同的薄膜/涂层厚度，使测量范围扩展到 0.1um -200 um。

Short Application UV VIS

Film thickness and transmittance measurements of foil in SPECORD® 250 Plus

At SPECORD® 250 Plus is ordered a hashing grating before the real monochromator. Appearing scattered light is clearly reduced, on the one hand, by this predecomposition of the light. On the other hand the measuring area to absorption ± 4 is extended in the area to 900 nm, i.e. transmission measurements and reflecting measurements can be carried out with higher delicacy.

Film thickness measurement with variable angle reflectance attachment

With this accessory, you can determine path length and refractive index of solid samples. This is done by measuring the reflectance at different angles of reflection over a defined wavelength range. Prior to the sample measurement, you must take a reference measurement inserting the provided mirror in place of the sample.

For the calculation of the film thickness, a special software was used. This software facilitates a measurement of a thin transparent film in a thickness range from 0.1 to 200.0 µm. Interference spectra from the reflected light dependent on the geometric layer thickness and the refractive index. The optical layer thickness is measured, which is the product of the geometric layer thickness and the refractive index.

Higher accuracy is achieved when an existing dispersion is known and based on the Cauchy-coefficient from the result algorithm. The Cauchy-coefficients are provided to the part of program from the material entered dispersion function n = n (λ).

The calculation of the layer thickness of a sample of known refractive index takes place with the following formula:

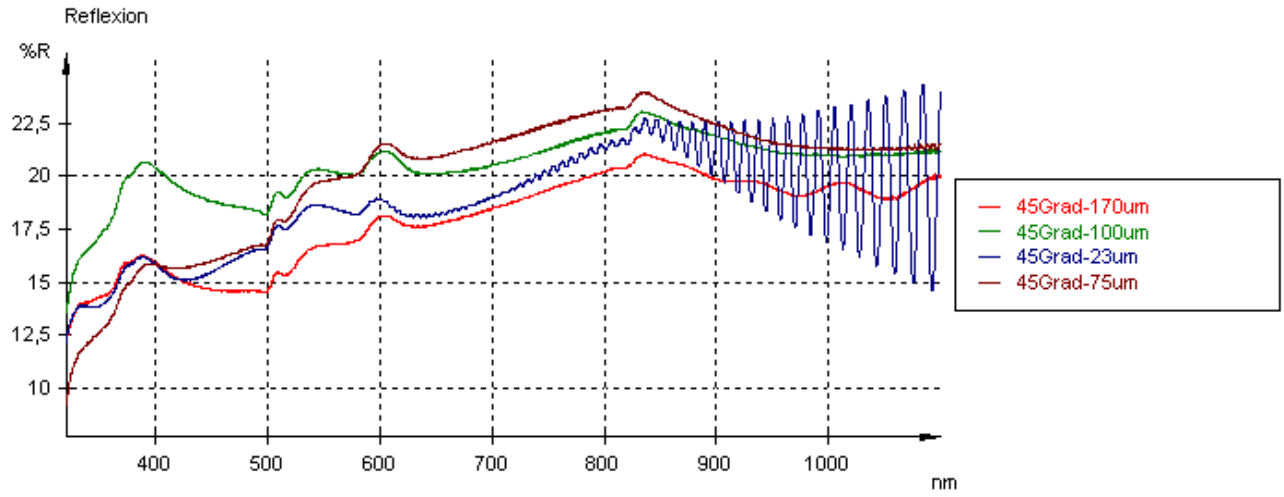
$$d = \frac{m \cdot \frac{\lambda_2 \cdot \lambda_1}{2(\lambda_2 - \lambda_1)}}{\sqrt{n^2 - \sin^2 \Theta}} \quad ; \lambda_2 > \lambda_1$$

d: Thickness of sample
m: Number of interference maxima after zeroth order maximum (see Example)
n: Refractive index of sample
Θ: Adjusted angle of reflection
λ_1: Wavelength of zeroth interference maximum
λ_2: Wavelength of m^{th} interference maximum

For the measurements a reflectance attachment with variable angle with an angle of 45° were used. The measurements of foil with different film thickness (23 µm, 75 µm, 100 µm und 170 µm) were taken with following parameter settings:

Cyclus:	None	**Meas. mode:**	Scan mode
Correction:	Reference	**Range [nm]:**	320-1100
Display:	Reflectance	**Delta lambda [nm]:**	0.2
Lamp change:	320 nm	**Integration time [s]:**	0.02
Slit:	4 nm	**Accessory**	Reflectance (variable angle)

In the following picture the reflection spectra of 4 foils are displayed.



As an example the reflectance spectrum of foil with a film thickness of 23 µm was evaluated with a special software for film thickness calculation. As a material plastic with denoted refractive index below and Cauchy-coefficients was selected. Following film thickness was determined:

Spectral interpretation-range (in nm): 700 - 1100
Expectancy range for film thickness (in µm): 1 - 100
S/N-measure (in db): 20

Refractive index (1.Peak): N1 = 1.52
Cauchy- coefficients (1.Peak): B1=-2.97651e-012, C1=7.71422e-011

1. Sample
- 1.Peak (opt./geom.): 33.904 / 22.306 µm

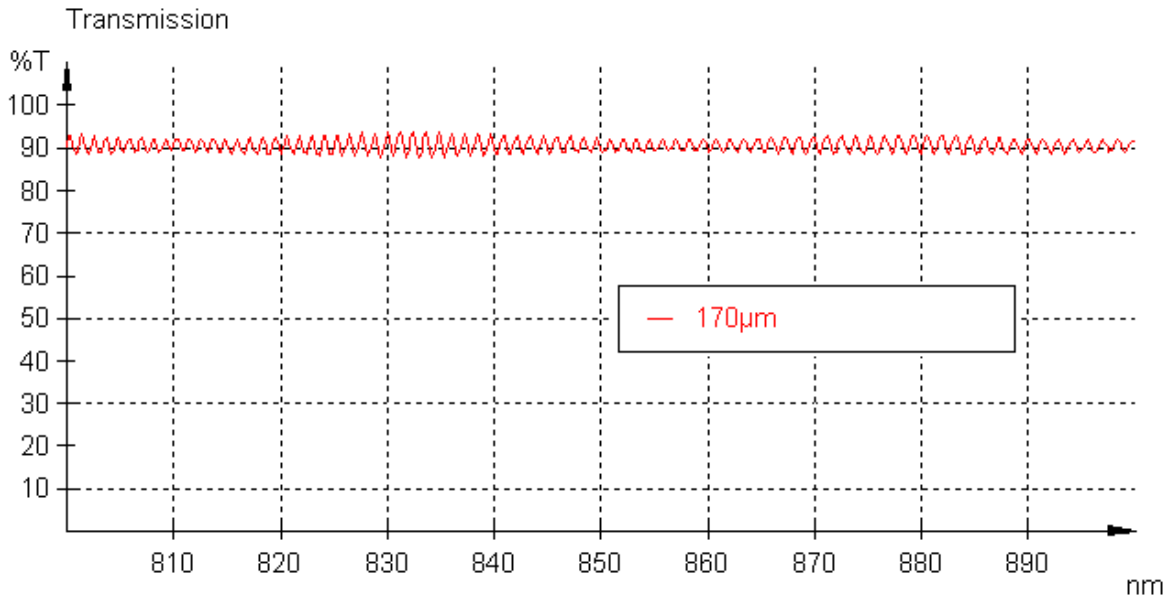
Here a very well correspondent value of 22.3 µm is to be ascertained for the foil slide with 23 µm of film thickness.

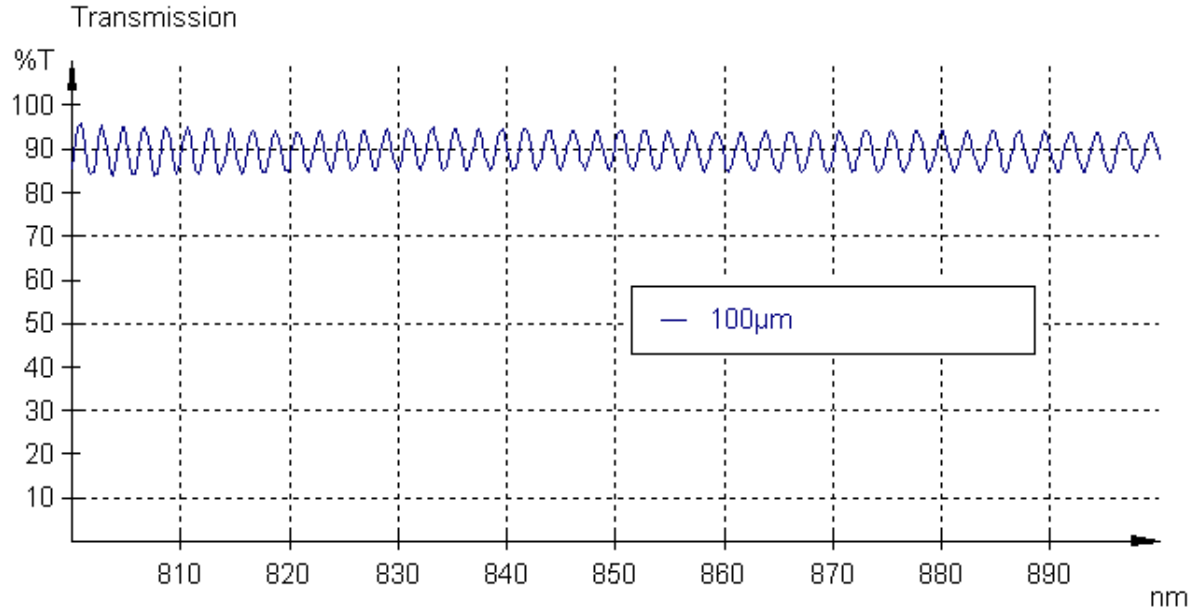
The transmittance measurement of 4 Foil with different film thickness

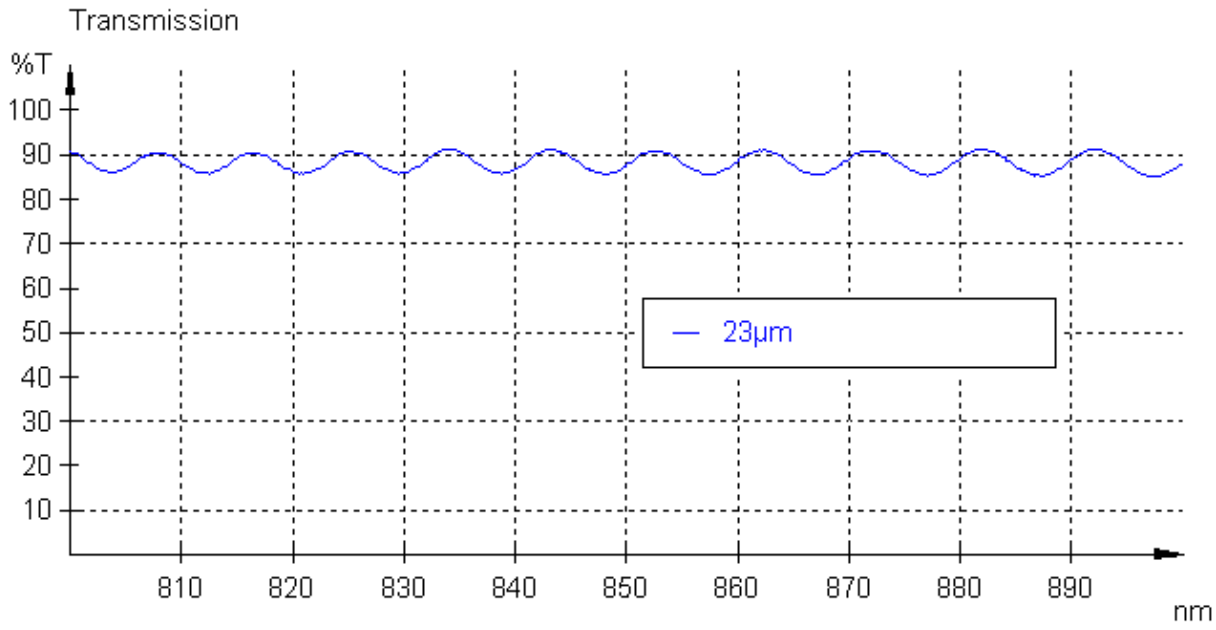
For this aim was used a solid sample holder. Following parameter settings were used:

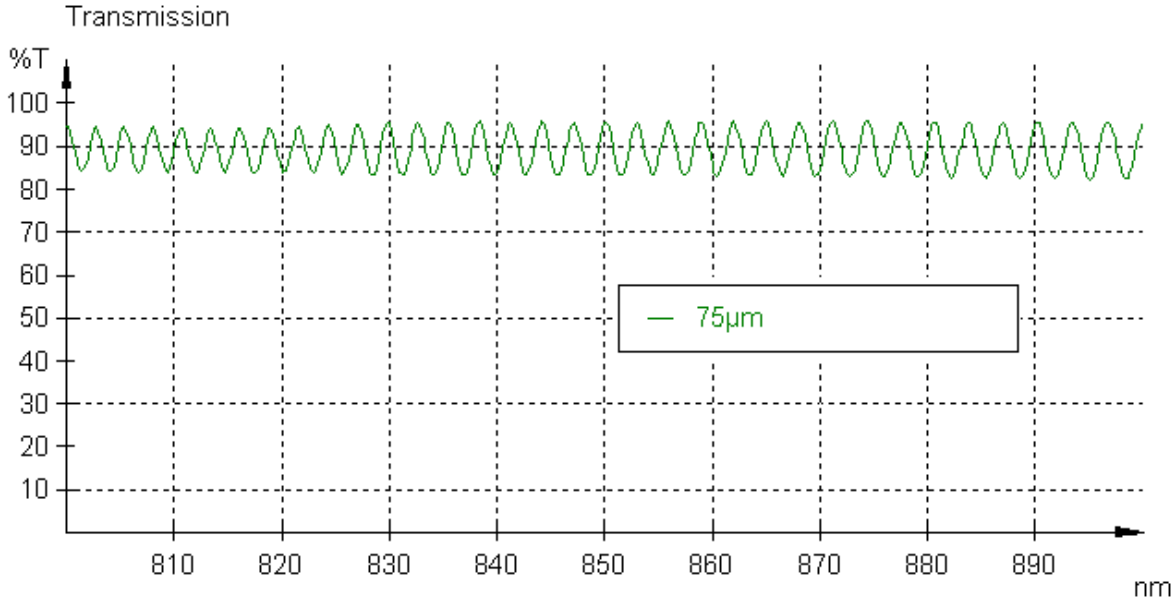
Cyclus:	None	**Meas. mode:**	Step mode
Correction:	Reference	**Range [nm]:**	800-900
Display:	Transmittance	**Delta lambda [nm]:**	0.2
Lamp change:	320 nm	**Integration time [s]:**	1
Split:	0.5 nm	**Accessory**	None

The reference measurements were carried out against air.









A correlation is clearly indicated between film thickness and transmittance spectra of foil. The distance from maximum to maximum is bigger (ca. 9.2 nm) at foil with smaller film thickness (23 µm) and smaller (ca. 1.2 nm) at foil with bigger film thickness (170 µm).

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