Precise Characterization of
Dielectric Stacks
by Spectroscopic Ellipsometry (SE)

Precise knowledge of optical properties of dielectric materials is needed for photonics device design such as high reflective mirrors used in the laser cavity, anti-reflection coatings to improve energy input efficiency, and many different types of filters. The optical properties of the films, however, depend on deposition technique. Therefore, it is necessary to precisely characterize optical constants with proper tool. Ellipsometry known as an absolute, non-contact, non-destructive optical technique, is particularly suitable for thin film characterization. Ellipsometry determines the change in polarization state of the light after its interaction with the sample. A typical ellipsometer comprises a light source, a polarization generator (Polarizer), polarization Analyzer and a light intensity detector. ***Spectroscopic ellipsometer (SE)*** determines the change in the polarization state of the light over a wide spectral range, and therefore allows to characterize very precisely not only layer thickness, surface roughness and interface layers, but also optical constants, index of refraction and coefficient of extinction, of the materials.

Figure 1. SOPRA GES-5 Angular SE

Figure 2 Thickness (nominal ± precision)

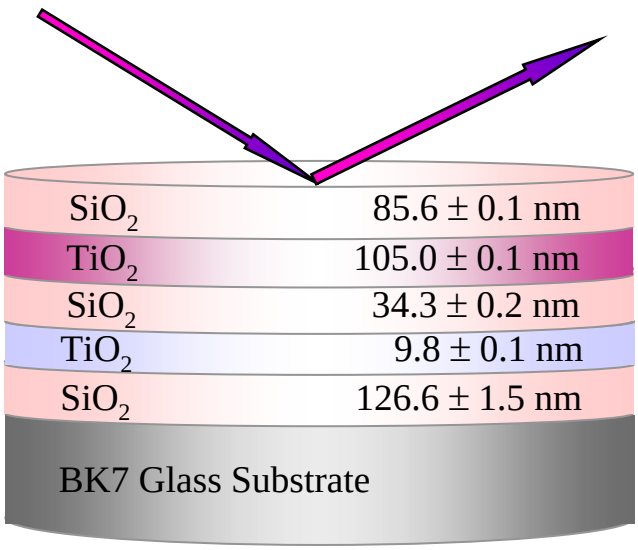
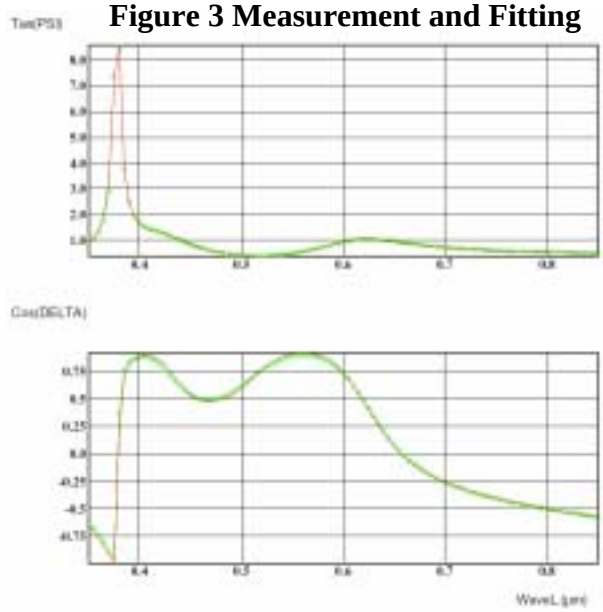
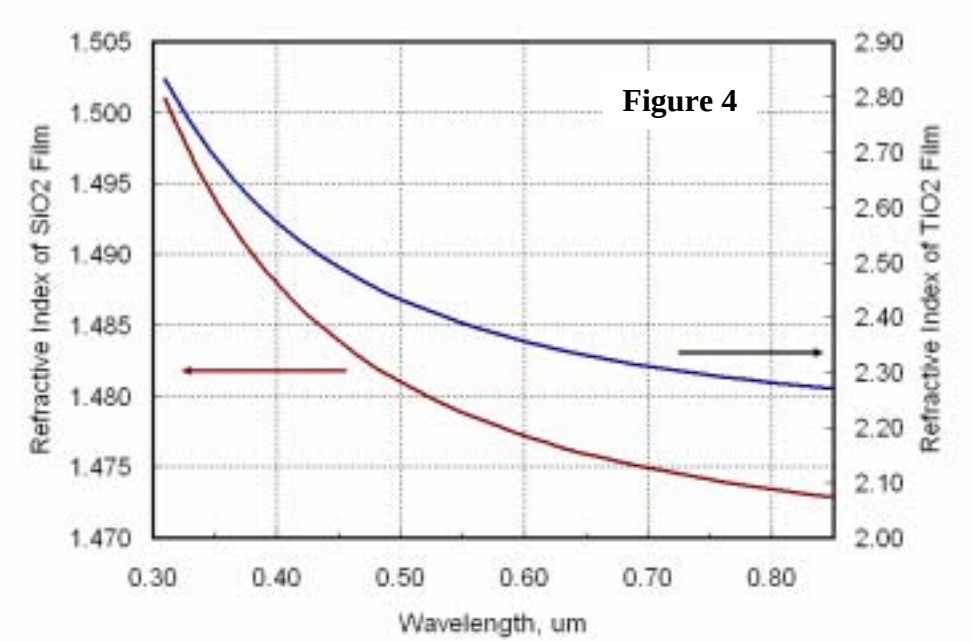


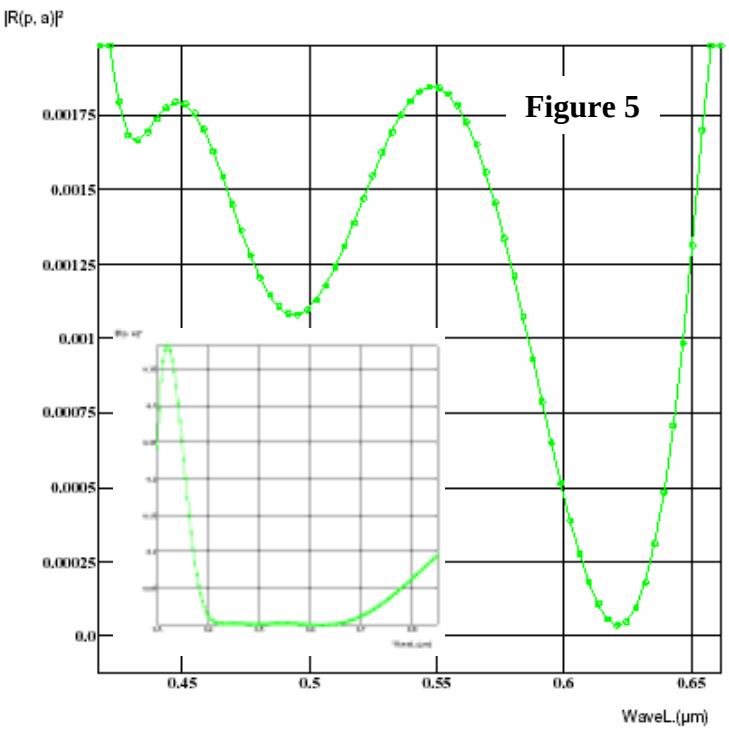
Figure 3 Measurement and Fitting



A characterization example of multi-layer dielectric stack with five layers is shown here. The refractive indices for both SiO2 and TiO2, and the thickness for all five layers can be precisely and simultaneously determined.

(*)Refer to SOPRA web page (**www. SOPRA-SA. com**) for tutorial on SE principles, terminology and products.





Refractive indices for SiO2 and TiO2 obtained from ellipsometry analysis are shown in Figure 4. Based on information obtained here, the optical behavior for this stack can be simulated with SOPRA **WinElli** modeling software. It can be seen that the minimum reflectivity (only 0.003%) for this stack is located at 622nm wavelength (Figure 5).

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