Basics of Ellipsometry

Ellipsometry measures the change in polarisation state of light after reflection from the surface of the sample. The experimental data are usually expressed as two parameters and that are related to the Fresnel reflection coefficient Rp and Rs by :

$$\rho = \frac{R_p}{R_s} = \tan\Psi e^{i\Delta}$$

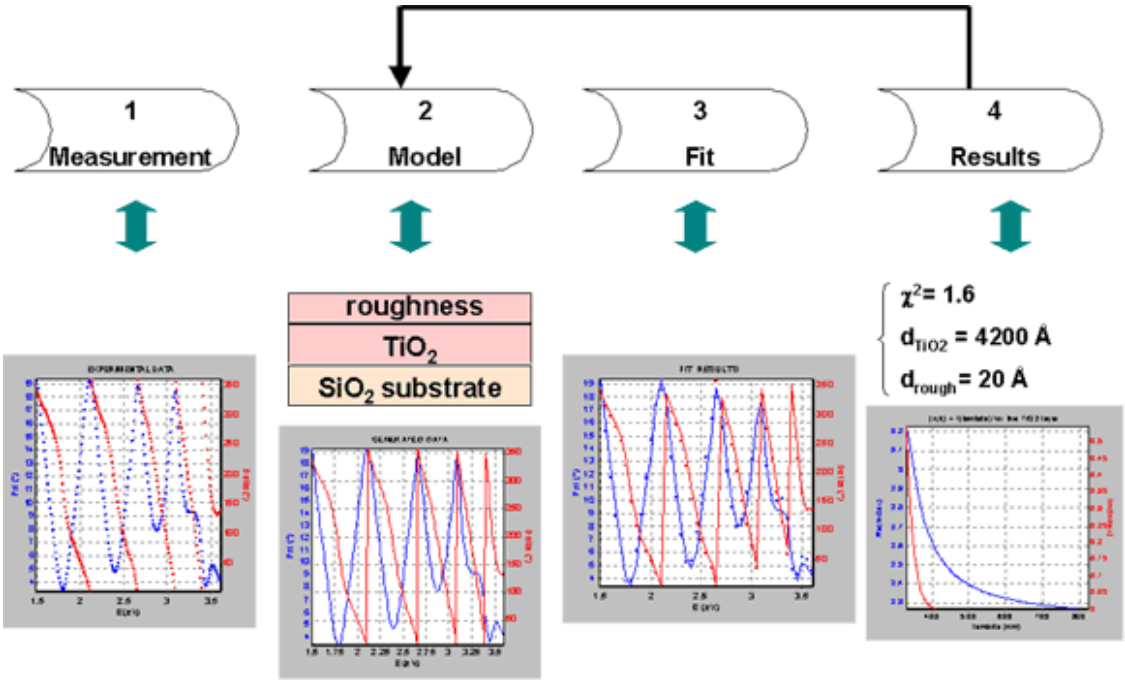
These two coefficients contain information related to material optical properties and physical dimensions. Spectroscopic ellipsometry measures this complex ratio as a function of wavelength.

Ellipsometry is a **model dependent technique** that is to say you can not access directly to the physical quantities you wish to determine (dielectric functions, refractive indices, material compositions, film thicknesses etc). A **mathematical model** that described the sample structure is required to determine them.

Then the fitting process is used to adjust the theoretic sample (previously built) to the experimental data (real measure). The data fitting is performed using the **iterative fitting algorithm** (Levenberg-Marquardt, Simplex). It is designed to minimise the value of the χ^2 - residue parameter by adjusting the sample fitting parameters. **Parameter** χ^2 is used to describe how close the generated data matches the experimental ones.

$$\chi^2 = \min \sum_{i=1}^{n} \left[\frac{(\Psi_{th} - \Psi_{\exp})_i^2}{\Gamma_{\Psi,i}} + \frac{(\Delta_{th} - \Delta_{\exp})_i^2}{\Gamma_{\Delta,i}} \right]$$

The next figure shows the course to be followed to analyse a sample.



Sample analysis procedure