

New Software Feature: Uniqueness Fit

Ellipsometric characterization begins with precise measurements, followed by a model that successfully matches the measurement curves. This process is concluded by deciding whether the model is correct. Fit parameter sensitivity and model uniqueness are often called into question. When in doubt, the questionable fit parameter can be fixed at a new value while allowing the other fit parameters to vary. If a similar MSE is possible, there is inadequate sensitivity to that fit parameter.

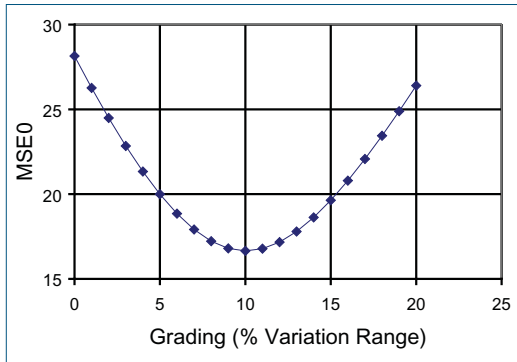


Figure 1

Consider a dielectric coating on silicon. The final model is a graded Cauchy, with five “fit” parameters: Thickness, three Cauchy parameters (An, Bn, Cn), and “% Grading Variation”. The model provides a good MSE – matching all experimental curves. How sensitive is the result to grading? To answer this question, first compare this result to the non-graded model fit. If the MSE decreases for the graded model, how sharp is the MSE minimum? The Uniqueness Fit can calculate the MSE with different amounts of Index Grading. At each “% Grading” value, the other parameters are fit to find the best MSE, which is recorded as shown in Figure 1. This Uniqueness Fit shows high sensitivity to the index gradient, which is determined to be 10%.

How it works:

To use Uniqueness Fit, choose this option under the Fit Studies menu of the Fit Window. A dialog box (Figure 2) will appear. Choose the fit parameter to vary and the desired range.

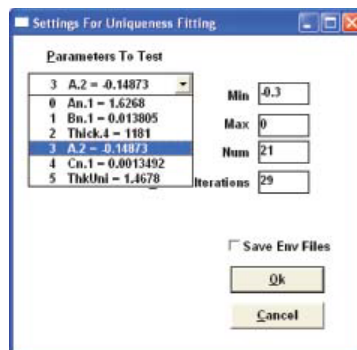


Figure 2

At each value, the remaining “fit” parameters are varied to find the best MSE. Results are recorded in an RTF (rich text format) file window upon completion. Scroll to the bottom of this RTF window to find MSE graphed versus varied Fit Parameter. Copy this table into a spreadsheet for additional graphing and manipulation, if desired.

In the next example, a transparent, anisotropic thin film is fit with a Uniaxial anisotropy model. The experimental data and final model fit are shown in Figure 3. Sensitivity to Anisotropy is visualized by testing the ‘Index Difference’, as shown in Figure 4.

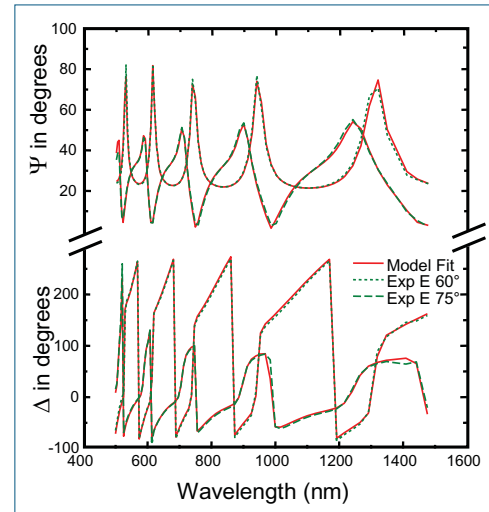


Figure 3

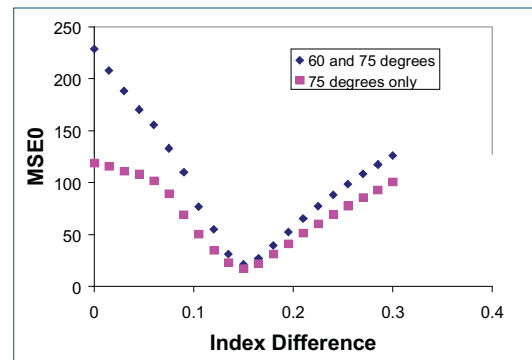


Figure 4

It has been suggested that anisotropic film measurements require multiple angles. However, this is disproved by comparing the Uniqueness Fit from a single angle measurement to the one obtained from a two-angle measurement. Both provide a common answer, although with different sensitivity.