

UV-Absorbing Films

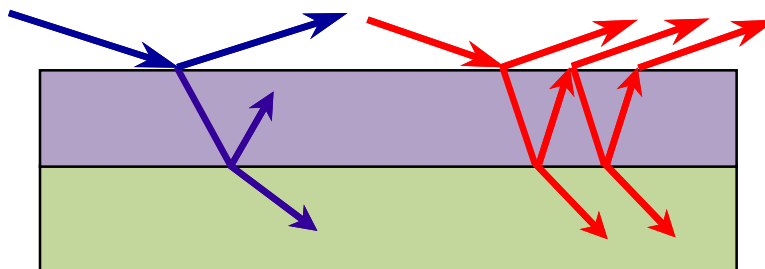
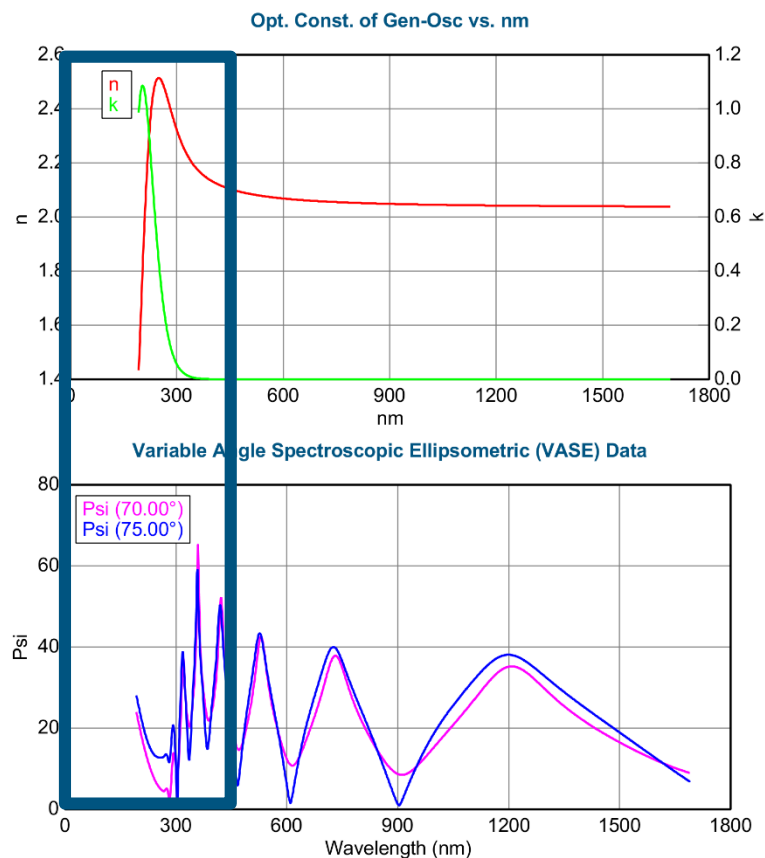
This note contains information related to procedures needed to determine refractive index and thickness of a transparent film with UV absorption. The film should be 20nm or thicker and have good optical contrast with the substrate material.

Ellipsometer types	M-2000, RC2, alpha-SE
Software	CompleteEASE
Typical data required	Standard ellipsometric data at 2-3 angles between 50°-75°
Typical model required	Si with Transparent Film.mod
Considerations	-At what wavelengths is the film transparent? -What is substrate material? -Is backside of substrate polished or rough?



When To Use This Procedure

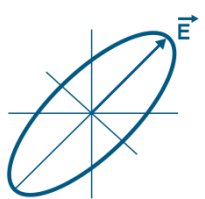
- When the data indicate UV absorption and you are interested in these wavelengths
- UV-absorbing films have oscillations at long wavelengths where film is transparent; these oscillations will dampen and eventually disappear with absorption



1. Measure Sample

- Typical data for this application requires standard ellipsometric data in reflection mode 2-3 angles between 50° - 75° .
- Consult hardware manual if needed.

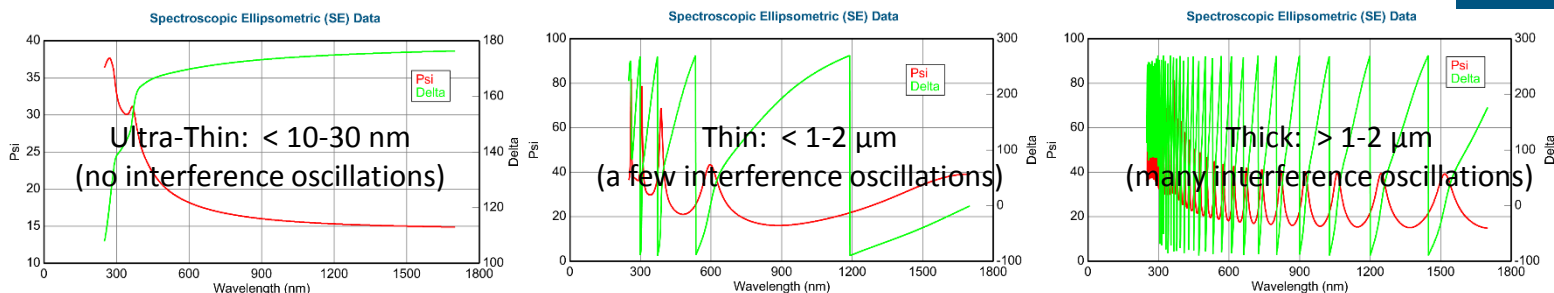




2. Determine Where Film is Transparent

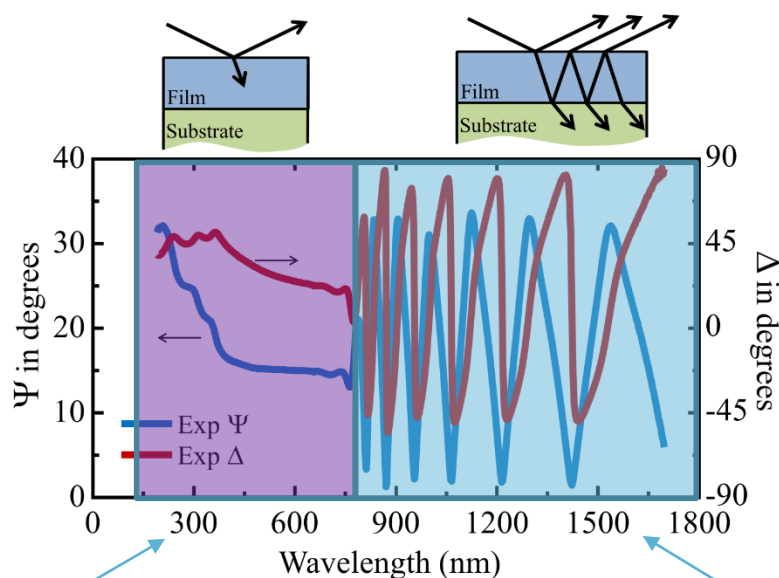
- Your data may have few or many interference oscillations

This procedure will work best for thin films ranging from ~ 30 nm to ~ 1 μ m.



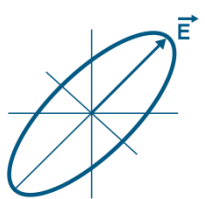
- Your data may have oscillations at all or only some measured wavelengths

The film is likely transparent where oscillations are $\sim$ uniform and undamped.



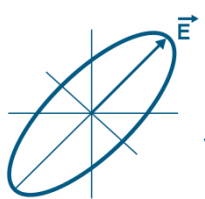
Absorbing region –
exclude this range from analysis

Transparent region –
use this range for analysis



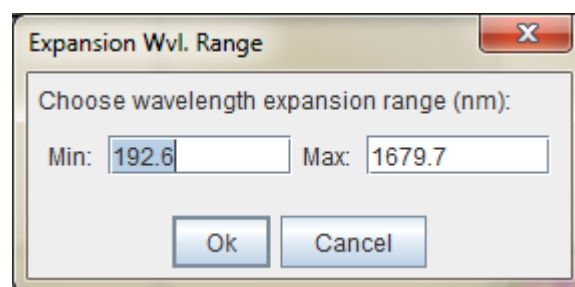
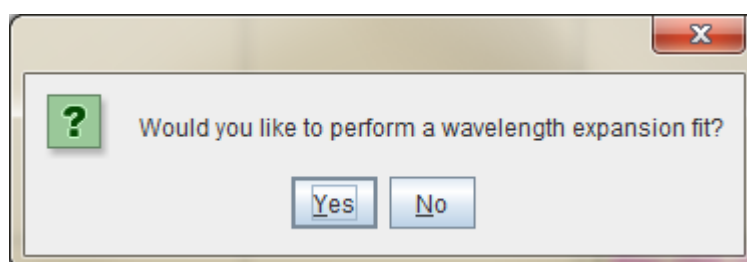
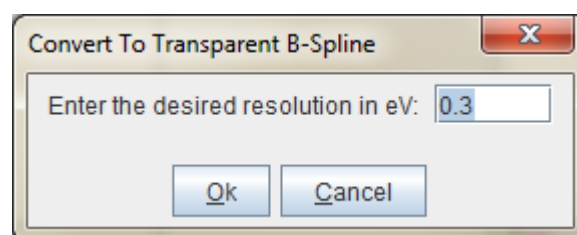
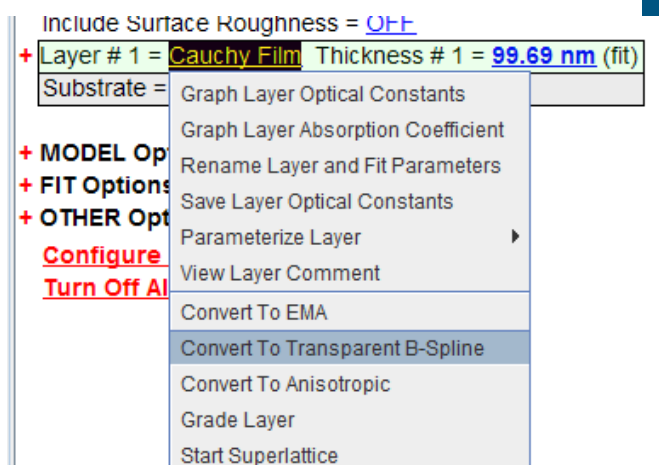
3. Follow Procedure for Transparent Films

- See corresponding note for Transparent Films to analyze the transparent region of the UV-Absorbing film
- After a good result is obtained in the transparent region, expand analysis to include absorbing region with the following steps



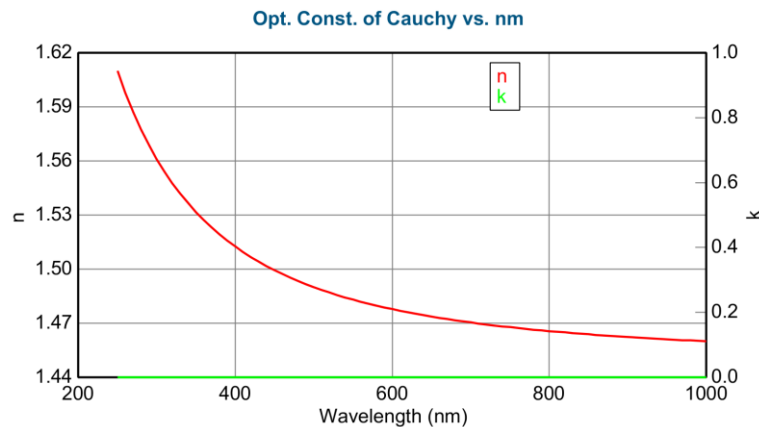
4. Expand Analysis to Absorbing Region with B-Spline

- Right click on “**Cauchy Film**” and select “Convert to Transparent B-Spline”
- Enter desired B-Spline node resolution. Default of 0.3eV should work well for a single broad absorption feature in the UV.
- Choose “Yes” to perform a wavelength expansion fit.
- Enter expansion wavelength range. Default values will include the full measured range.
- Using this procedure, the B-Spline layer will assume transparent region based on the transparent analysis range.



5. Evaluate Results

- Below are a few basic criteria to consider:
 - The model generated data should match the measured (experimental) data.
 - The model should be unique.
 - The model and fit parameters must be physically plausible.
- Where the material is transparent, n should only increase with decreasing wavelengths:



- Where the material is absorbing, n and k should maintain Kramers-Kronig consistency (this is forced by software using procedure on previous page)