

# UV-Absorbing Films

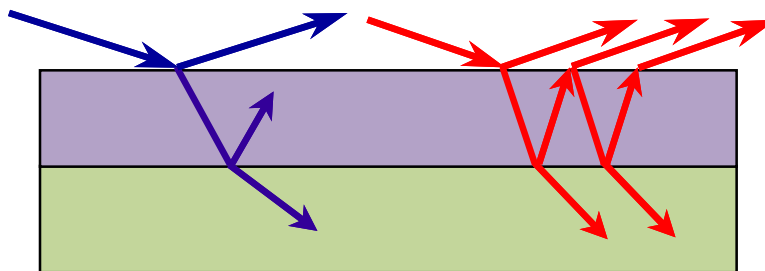
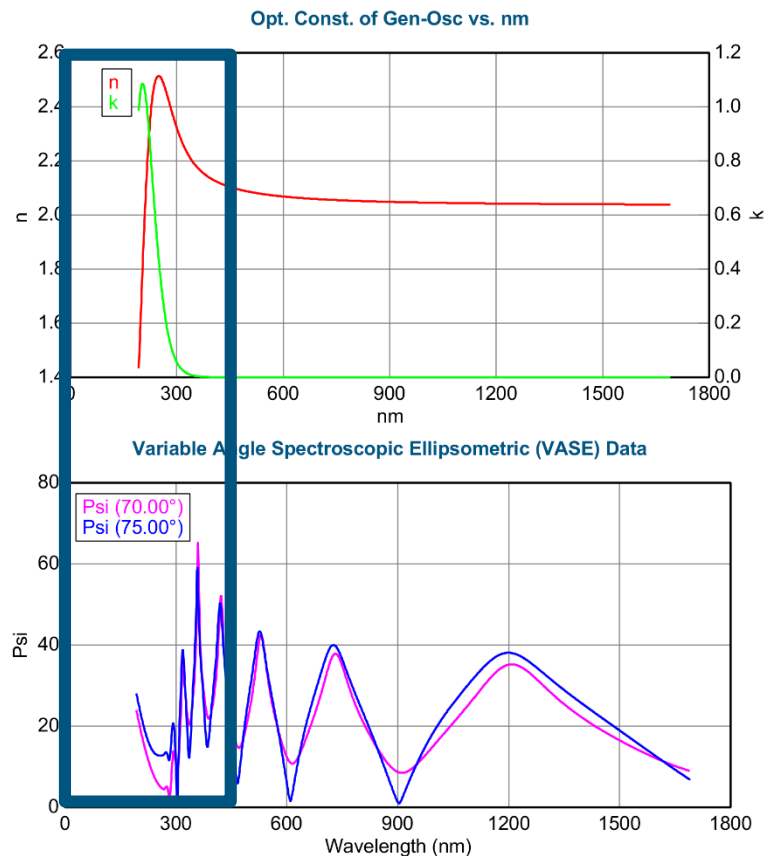
This note contains information related to procedures needed to determine refractive index and thickness of a transparent film with UV absorption. The film should be 20nm or thicker and have good optical contrast with the substrate material.

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	<ul style="list-style-type: none"> <li>-At what wavelengths is the film transparent?</li> <li>-What is substrate material?</li> <li>-Is backside of substrate polished or rough?</li> </ul>



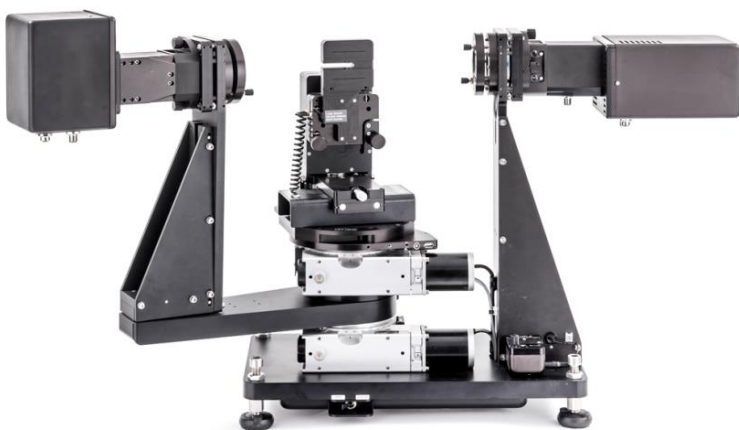
# When To Use This Procedure

- 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  $50^\circ$ - $75^\circ$ .
- Consult hardware manual if needed.

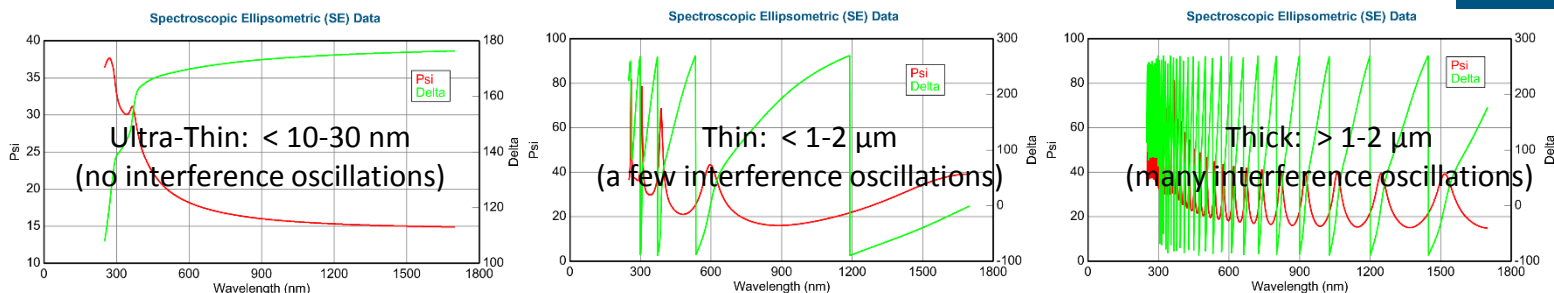




## 2. Determine Where Film is Transparent

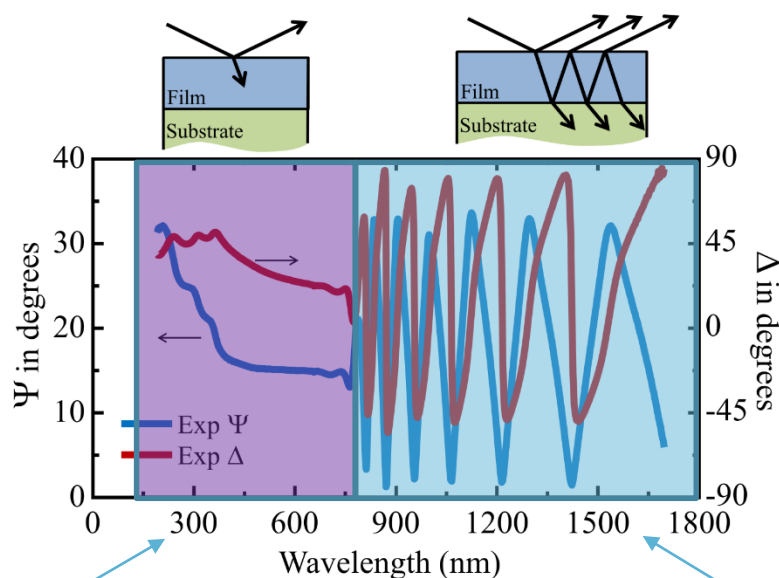
- Your data may have few or many interference oscillations

This procedure will work best for thin films ranging from  $\sim 30$  nm to  $\sim 1$   $\mu$ 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.



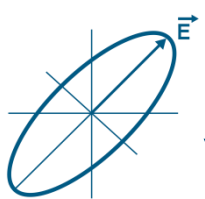
Absorbing region –  
exclude this range from analysis

Transparent region –  
use this range for analysis



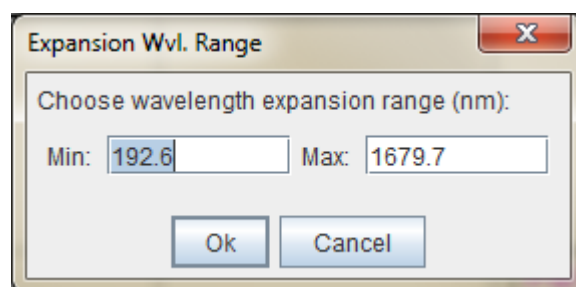
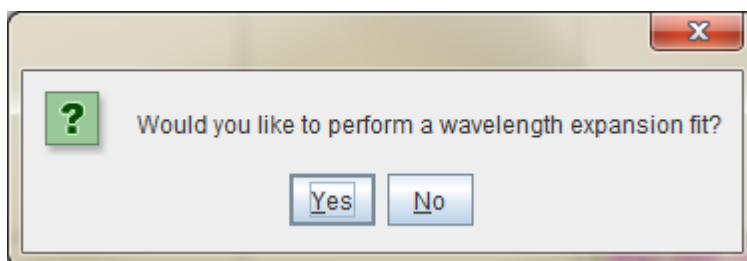
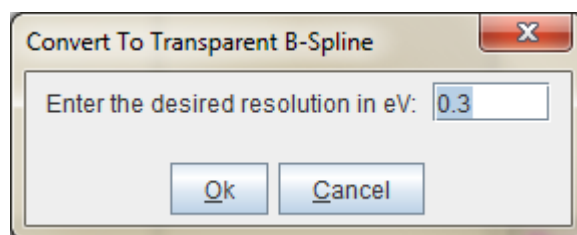
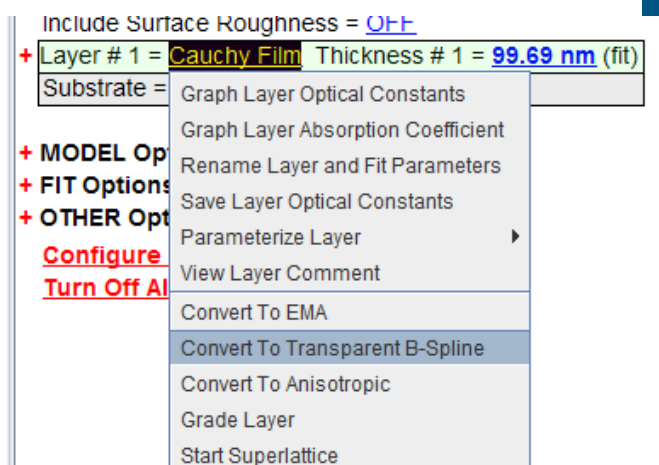
### 3. Follow Procedure for Transparent Films

- 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

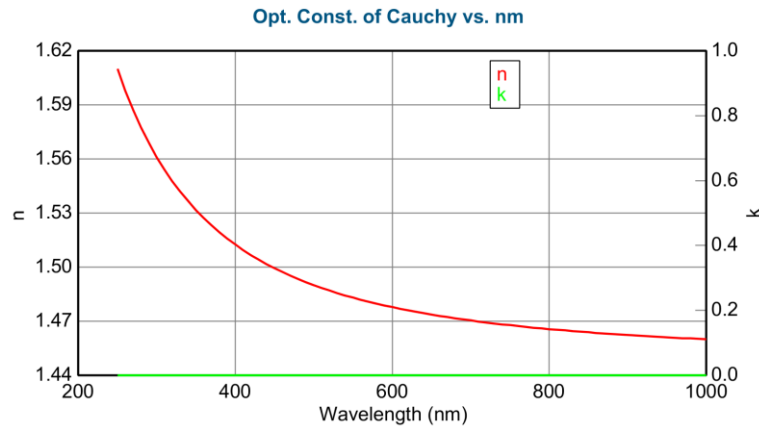
- Right click on “**Cauchy Film**” and select “Convert to Transparent B-Spline”
- Enter desired B-Spline node resolution. Default of 0.3eV should work well for a single broad absorption feature in the UV.
- Choose “Yes” to perform a wavelength expansion fit.
- Enter expansion wavelength range. Default 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:
  1. The model generated data should match the measured (experimental) data.
  2. The model should be unique.
  3. 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)