

Self-Assembled Monolayers

This note contains information related to procedures needed to determine thickness of a self-assembled monolayer. Gold is a typical substrate for this application, but the procedure can be modified for other substrate types.

Ellipsometer types	M-2000, RC2, alpha-SE
Software	CompleteEASE
Typical data required	Standard ellipsometric data at 1 or more angles between 50°-75°
Typical model required	Blank.mod
Considerations	-What is substrate material? -Typical monolayer thickness



Required Prep: Substrate Analysis

This application requires that the substrate is well characterized prior to measuring the SAM.

For gold or other metal substrates, follow procedure in “Metal Substrates” note. It is important to save the optical constants when finished.

For semiconductor substrates with native oxides, follow the procedure in “Silicon Substrates” note. It is important to save the full model structure when finished, or note the native oxide thickness result.

SAMs are optically similar to glass, therefore this application does not usually work well with glass substrates.

This application usually works best if same substrate is measured before and after SAM growth.



1. Measure sample or open saved data
2. Prepare model with known substrate information:

- For gold, the model structure will start with loading the saved gold optical constants into a blank.mod
- For semiconductors, the model structure will start with the known substrate and previously measured native oxide thickness

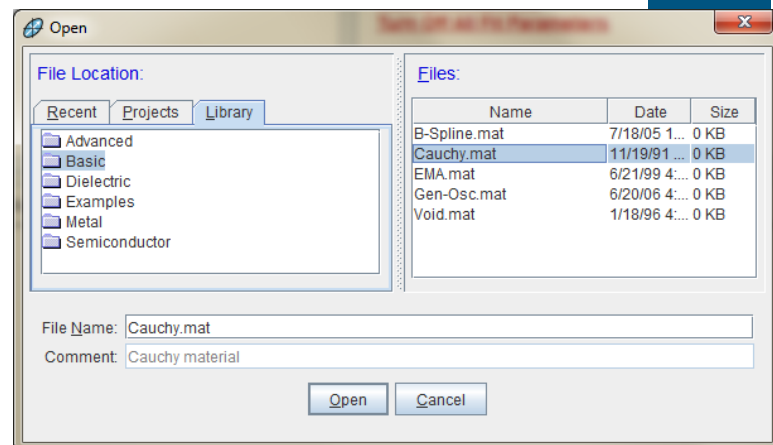
Substrate = [previously measured bare Au](#)

Layer # 1 = [NTVE_JAW](#) previously measured thickness = [15.62 nm](#)
Substrate = [Si_JAW](#)

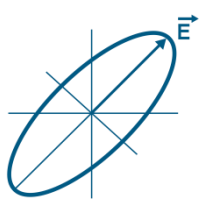
3. Click on Layer Command **Add** to open material file library

Layer Commands: **Add Delete Save**

4. Browse Library tab, Basic folder to find Cauchy.mat. This will represent the SAM material.



5. Click "Open" to add the material file to the model structure



6. Right click the Cauchy layer thickness to turn this ON as a fit parameter. Note this should be the ONLY activated fit parameter.

7. From the **Fit:** panel, click 'Fit'

8. Evaluate results by considering:

- Does the model generated data visually match the experimental data?
- Is the SAM thickness reasonable?

Very Thin Films

Ellipsometry is very sensitive to the presence and thickness of sub-nm layers due to the phase change (Delta). However, ellipsometry is less sensitive to index of films less than 10-20nm, as the pathlength through the material is very small compared to the measurement wavelengths. For thicknesses in this range, it is best to assume an approximate index and determine thickness only. For SAMs, the default Cauchy values with index near 1.5 is a good assumption.

+ Layer # 1 = Cauchy SAM thickness = 0.00 nm (fit)
Substrate = previously measured bare Au

+ Layer # 2 = Cauchy SAM thickness = 0.00 nm (fit)
Layer # 1 = NTVE_JAW previously measured thickness = 15.62 nm
Substrate = Si_JAW

