Semiconsoft,Inc

Thin Film Measurement solution
Software, sensors, custom development
and integration

PARYLENE MEASUREMENT

SUMMARY

In this Application Note we discuss the measurement of Parylene coating thickness directly on a metal sample. The same approach can be used to measure Parylene coating on any other surface.

We will discuss steps to develop the filmstack and measurement results:

1. Quick estimate of the thickness using thick film algorithm. Since we do not know R.I dispersion, the result is not accurate. But we can use this approach for a quick measurement in production once we determine the R.I. dispersion
2. Measure uncoated surface of the part and build a filmstack to fit this data
3. Measure Parylene coating thickness and R.I dispersion

INTRODUCTION

Parylene (p-xylylene) polymers coatings are conformal and pinhole free – they are used as a moisture and dielectric barriers in many applications. There are several types of Parylene polymers: Parylene C, Parylene N, Parylene AF-4, Parylene SF, Parylene HT, Parylene X, etc. All these Parylene types have different chemical and optical properties, so the refractive index can vary significantly depending on the type of the material.

Parylene films are, typically, thick and it is easy to measure their thickness using FFT thick film algorithm, assuming the refractive index (dispersion of the material) is known. This approach does not require accurate calibration or detailed model of the filmstack – it is convenient in production environment. However, if the correct refractive index is not known – the thickness reading will be inaccurate as well.

83 Pine Hill Rd. Southborough, MA 01772
Phone +1.617.388.6832 Fax. +1.508.858.5473
email: info@semiconsoft.com http://www.semiconsoft.com

SAMPLE MEASUREMENT

MProbe 20 Vis was used for measurement of coated and uncoated sample in 400-1000nm wavelength range.

Fig. 1 Al sample with Parylene coating

To quickly estimate the thickness of the sample we use a thick film FFT based algorithm.

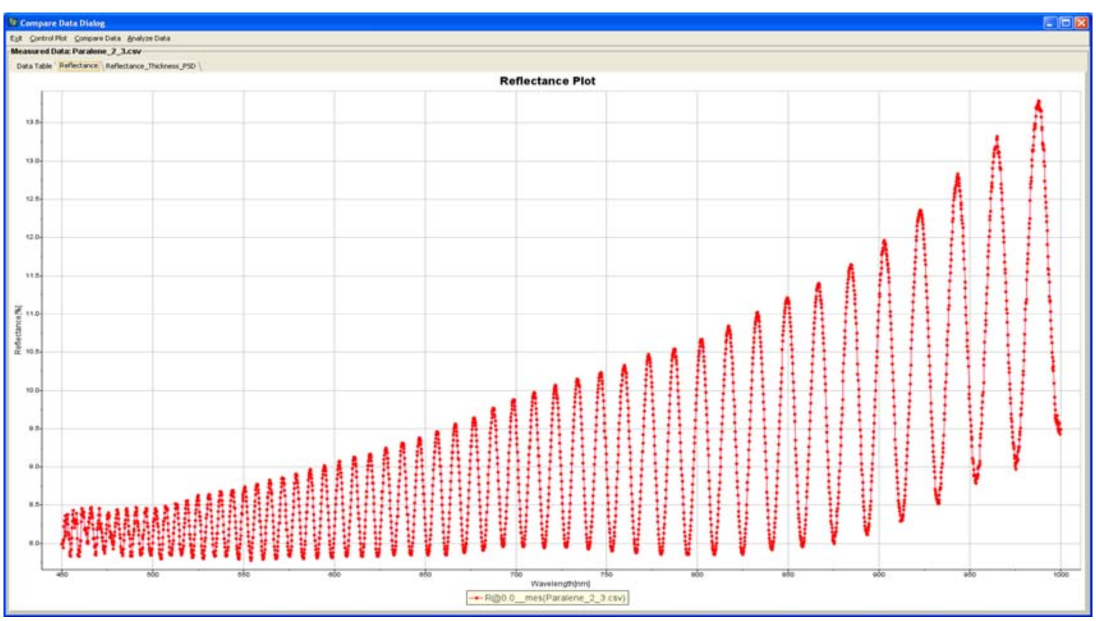

Fig. 2 Reflectance spectra of the thick Parylene layer on matted Al (Fig. 1).

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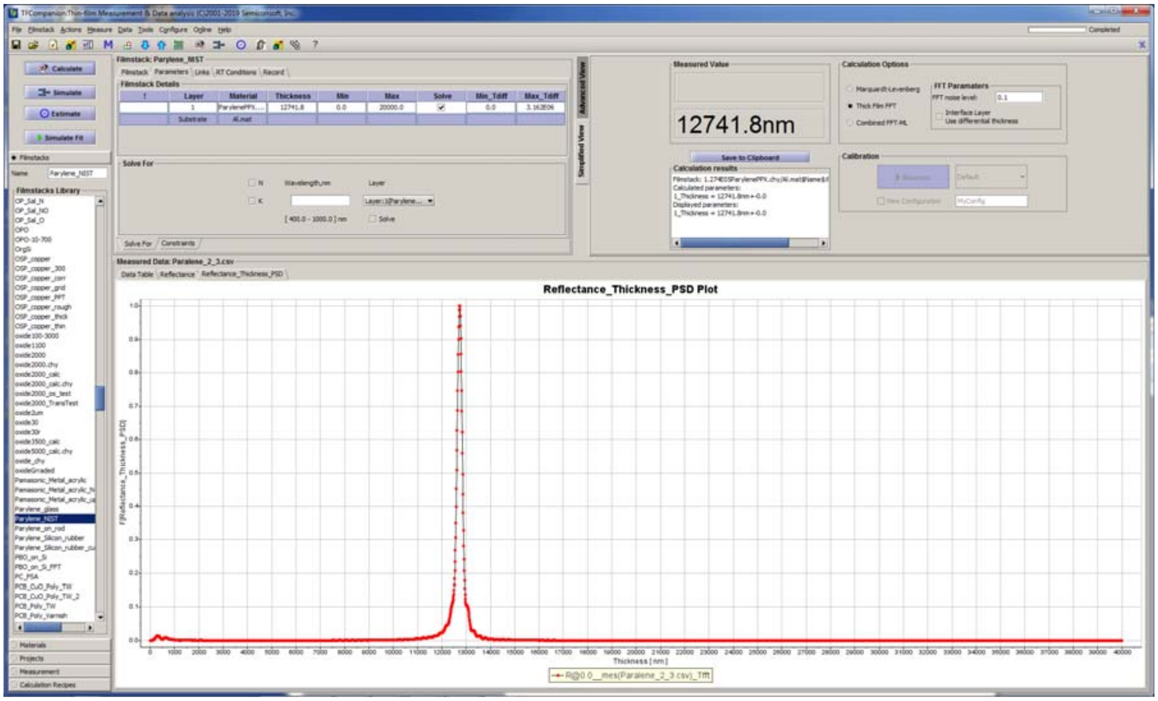

Fig. 3 Measurement results (12.7 µm) using thick film algorithm - Parylene X refractive index is assumed.

Since we do not know if the refractive index we used is correct, we need to verify the fit of the model to the measured data. This will allow us to determine both the refractive index and thickness more accurately

To measure the coating we first need to measure uncoated Al to determine the filmstack under the Parylene coating. The result of this measurement is displayed in Fig. 4.

There are several pieces of information that we determined from this measurement:

a). there is an Al oxide layer (~ 72 nm)
b). the surface roughness is ~ 30 nm
c). the reflectance of this Al sample is ~ 40% of the standard polished Al.
All this information is included in the model in order to achieve a good fit and will be used in our final model of the Parylene stack

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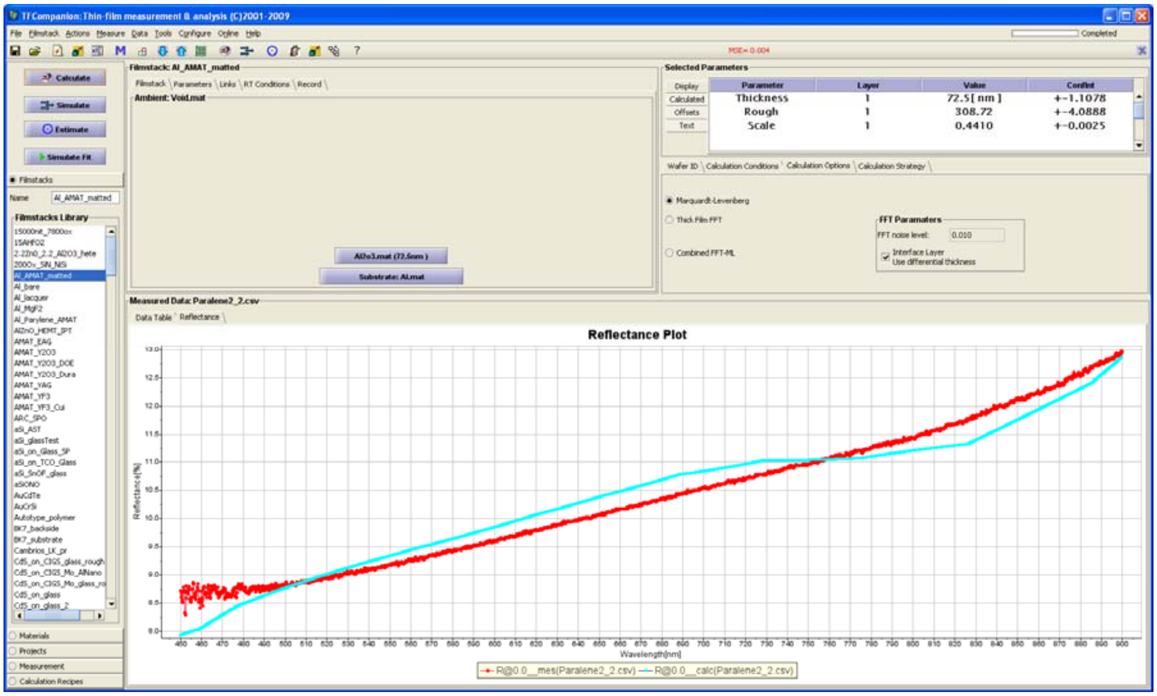

Fig. 4. The fit of the model to the measurement of the uncoated Al.

To check the results of our original measurement of the Parylene using thick- film algorithm we can overlay the model and the measured data and review the fit (**Fig. 5**). The period of oscillation is matching well, as we would expect, but the amplitude does not. This means that the refractive index, that we used, was not accurate.
In order to achieve a better fit, we need to adjust the refractive index and thickness (**Fig. 6**)

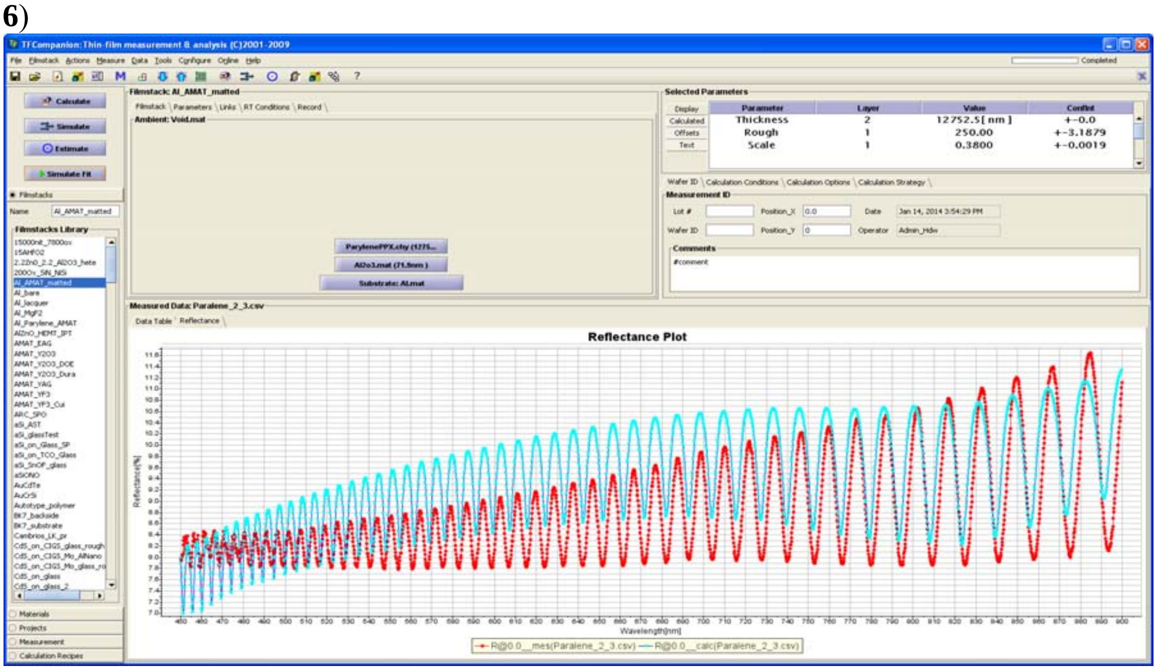

Fig. 5 Results of the original Parylene measurement (thick film algorithm) overlaid with the measured data.

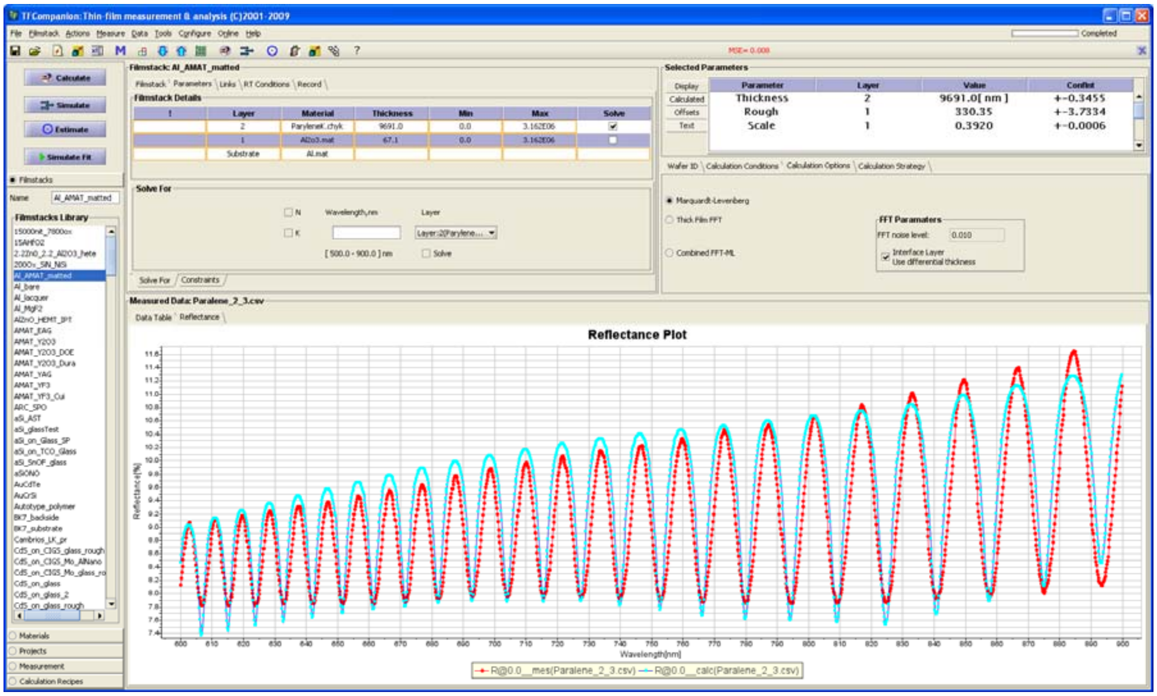

Fig. 6 The fit of the model to the measured data with thickness and dispersion adjusted. Both amplitudes and period are matched. (see refractive index dispersion on Fig. 7)

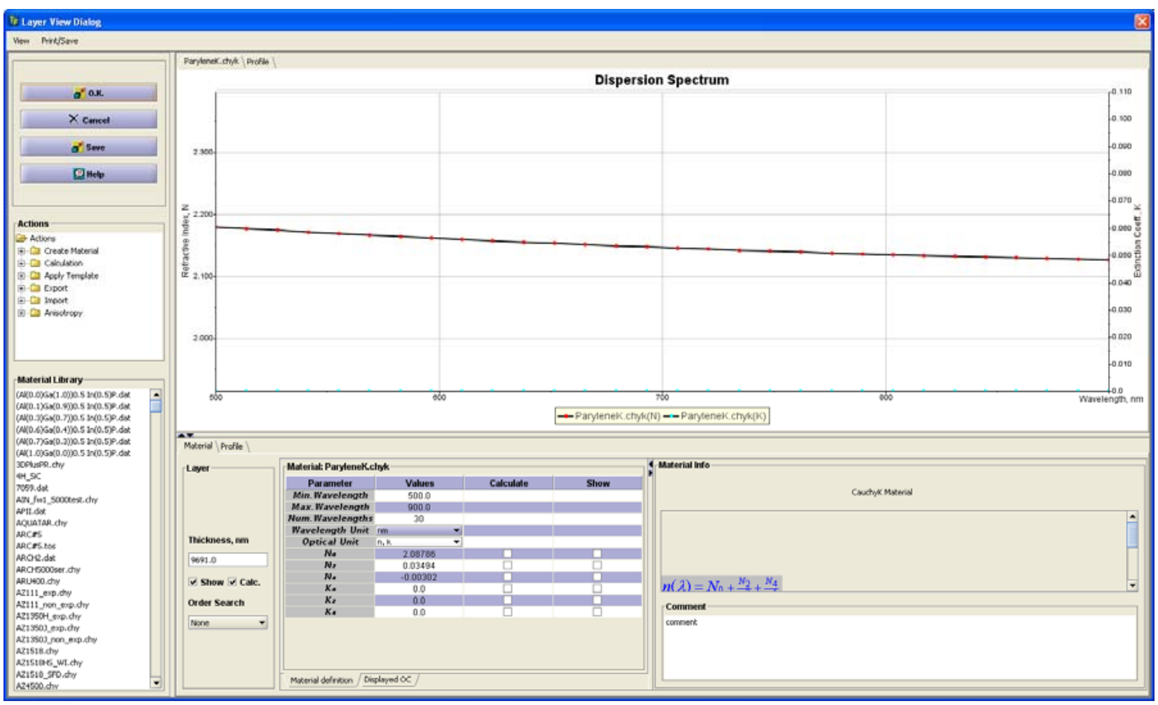

Fig. 7. Refractive index of the Parylene determined from the measurement is significantly higher (~ 2.15) as compared to ParyleneX (~ 1.67). As a result the actual thickness is 9.69µm vs. 12.7 µm that was originally determined using incorrect refractive index.

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Now we determined Parylene dispersion earlier from the direct fit to data. And can use it in the thick film algorithm,

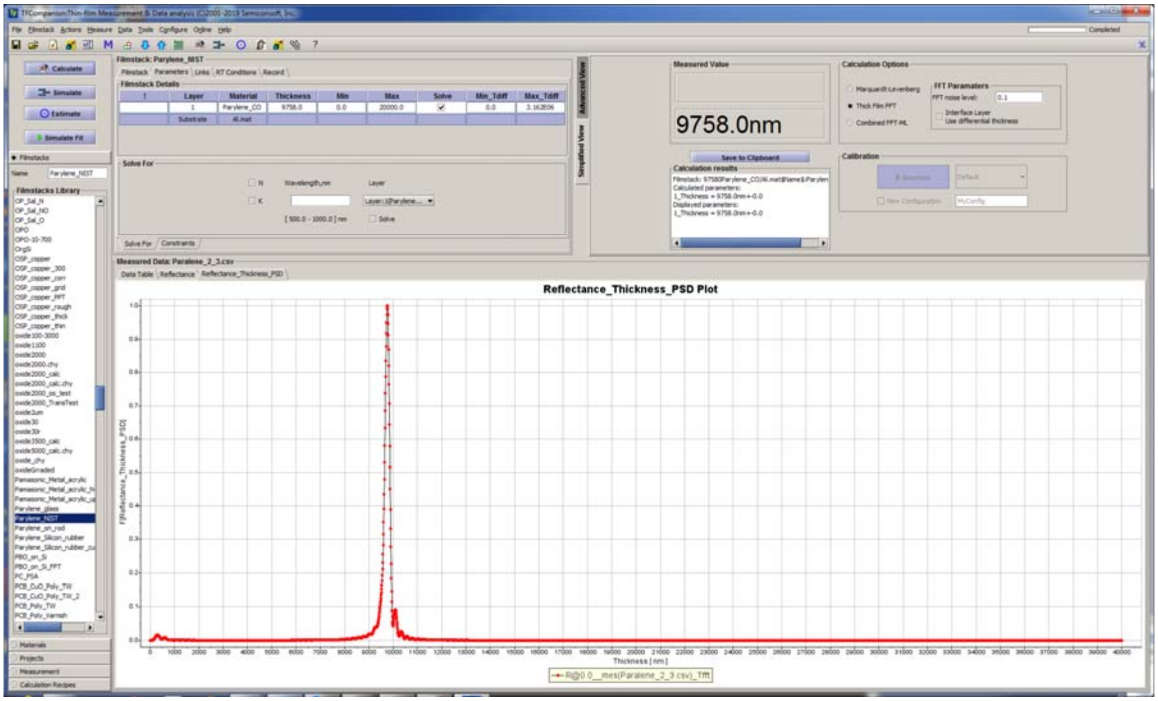

Fig. 8 Measurement with thick film algorithm using updated Parylene dispersion. The thickness result includes 67nm of Al oxide present on Al surface.

CONCLUSION

Using MProbe 20 Vis and described approach, one can easily determine R.I./ dispersion of the specific Parylene film simultaneously with the thickness, directly on the product sample. This dispersion data can be used with thick-film algorithm that is well suited for production environment for off-line or online measurement.

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