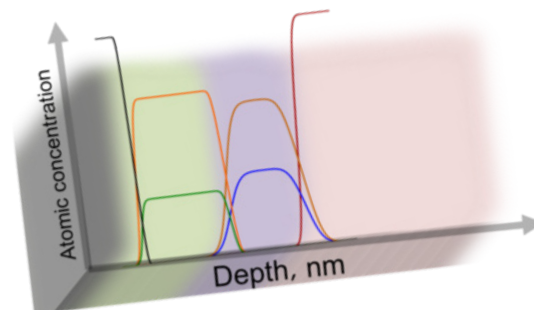
PHYSICAL ELECTRONICS
A DIVISION OF ULVAC-PHI



*Strata*PHI

Software for Thin Film Structure Analysis

Highlights

- *Strata*PHI is a new software product for estimating the structure of thin film stacks from spectral and angle-dependent XPS data.
- *Strata*PHI calculates thickness for thin film structures composed of discrete layers.
- For multi-layer samples with unique chemistry in each layer, thickness can be calculated from spectral data measured at a single take-off angle (TOA).
- Automated multiple data file handling for high throughput

Applications

- Multi-layer thin film thickness and composition
- Ultrathin 2-dimensional materials thickness and composition
- Adventitious carbon thickness
- Surface Coverage (atoms/cm^2)
- High-throughput metrology tool for thin film structures

StrataPHI 1.1.039

File Attentuations Lengths Material Systems Operation

ARXPS Measurements & Thickness Fit (--)

χ^2 = 8.439E-03 / 3.590E-06

O1s.Hf C1s Hf4f O1s.Si Si2p.O Si2p.Si

Normalized Intensity

sin(TOA)

s.1.1nmSiO2 2nmHfO2.csv Relative Depth Plot

ln[min/max]

C1s O1s.Hf O1s.Si Hf4f Si2p.O Si2p.Si

Measured Species

Estimated Sample Structure

C: 0.491 ± 0.035 nm
HfO2: 1.990 ± 0.088 nm
SiO2: 1.076 ± 0.172 nm

C1s Hf4f O1s Si2p

Concentration / %

Depth / nm

Layer

no mat sys file load...

	Material	t (nm)	+/-	/cm^2	Fix
1	C	0.4909	0.0345	5.1733e+13	☐
2	HfO2	1.9895	0.0884	5.5099e+13	☐
3	SiO2	1.0757	0.1723	2.8573e+13	☐
4	Si	100	0	4.9939e+15	☑

TOAs (deg)

30	☑
36	☑
45	☑
57	☑
76	☐

Calculation & Display

☐ Display elemental prof...

☑ Use restricted set for struc...

Fit/Thi... Reset

Export

☐ PowerPoint ☐ Excel ☐ Text

Data CSq ALs

PPT+ PPT> Excel+ Excel> File>

ChSq 5.2051e-04 0.0000e+00 0.0000e+00 5.1590e-03 8.6088e-04 1.3958e-03

Transitions/Speci

	C1s	O1s.Hf	O1s.Si	Hf4f	Si2p.O	Si2p.Si
C	☑	☐	☐	☐	☐	☐
HfO2	☐	☑	☐	☑	☐	☐
SiO2	☐	☐	☑	☐	☑	☐
Si	☐	☐	☐	☐	☐	☑

Attenuation Lengths AL ...\StrataPHIDB.xml AL Calibration

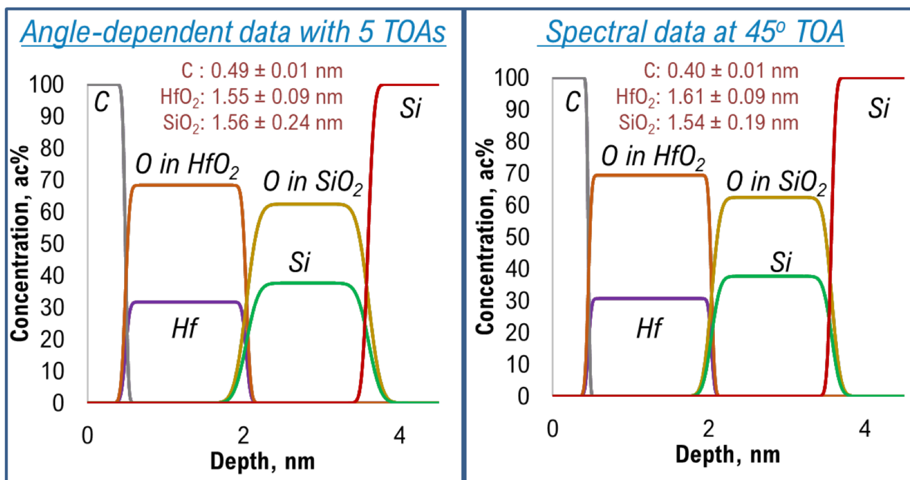
	C1s	O1s.Hf	O1s.Si	Hf4f	Si2p.O	Si2p.Si
C	2.6600	2.2000	2.2000	3.6000	3.0180	3.0180
HfO2		1.5600	1.5600	2.1800	2.0800	2.0800
SiO2			2.3700		3.3900	3.3900
Si						2.8200

Completed optimization (0.076 s)

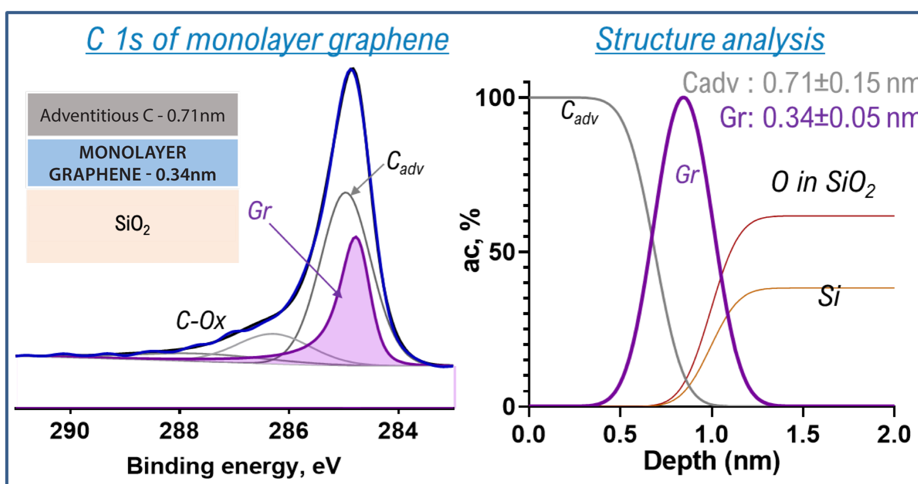
user name

*Strata*PHI

- Calculates thickness in nm and coverage in atoms/cm^2
- Calculates concentration depth profile
- Estimates thickness uncertainties
- Built-in database editor for material densities and attenuation lengths (ALs)
- Calculates ALs from reference samples with known layer thickness
- User-defined material system recipes can be saved and invoked for consistent treatment of multiple data sets for metrology and other applications
- Automated data file handling and calculations for high throughput
- Automated logging capability with export to Excel™, PowerPoint™, and text files
- Very fast calculation - less than 0.2 seconds
- Works for data from all PHI XPS instruments



Thickness of 3-layered system obtained from an angle-dependent dataset and from a single TOA. High accuracy of thicknesses can be extracted from a single TOA measurement.



Thickness of monolayer graphene film on SiO_2 substrate was extracted from the C 1s spectrum fitted using graphene reference spectra and a peak due to adventitious carbon.

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