PHYSICAL ELECTRONICS
A DIVISION OF ULVAC-PHI

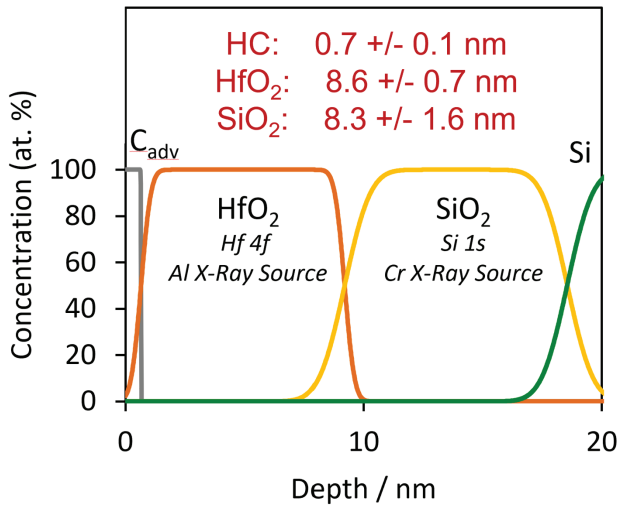
# *Strata*PHI 2.0

## *Thin Film Structure Analysis*

*Strata*PHI 2.0 is non-destructive depth-profiling software to estimate the structure of multi-layered thin films with thickness ranging from a monolayer to ~ 30 nm, achieved using angle-dependent XPS and HAXPES spectral data

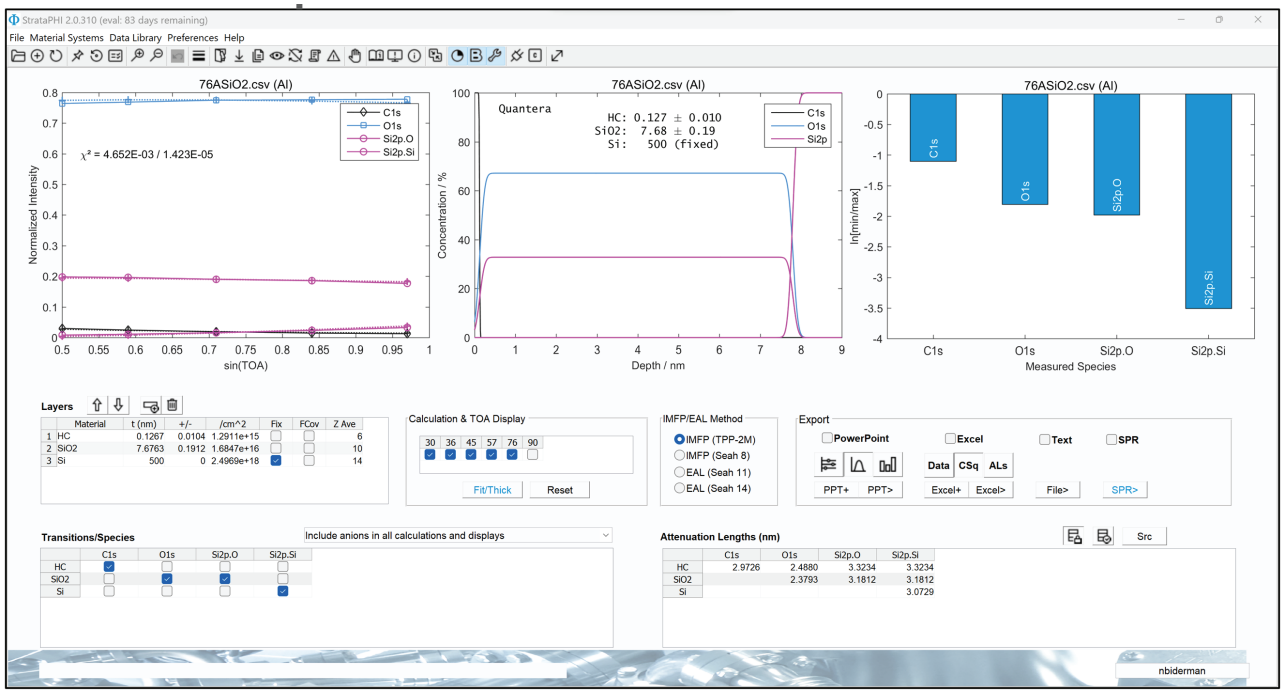
## Highlights

- Thickness can be calculated for thin film structures composed of discrete layers
- **New!** Angle-dependent XPS and HAXPES data of the same sample can be combined in *Strata*PHI 2.0 to enhance signal of layers at different depths
- **New!** Accurate calculation of fractional coverage
- **New!** Simulation mode to determine the best Al/Cr X-ray transitions to acquire for a given multi-layer thin film stack
- 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)




Thickness of thicker layers can be accurately obtained from combined angle-resolved XPS and HAXPES data in a single *Strata*PHI analysis of 8.2 nm $HfO_2$/8 nm $SiO_2$ on Si substrate. Si 1s transition from Cr X-ray source from tens of nanometers below the surface and Hf 4f transition from Al X-ray source closer to the sample surface are combined for structure estimation.

## *Strata*PHI 2.0 Graphical User Interface

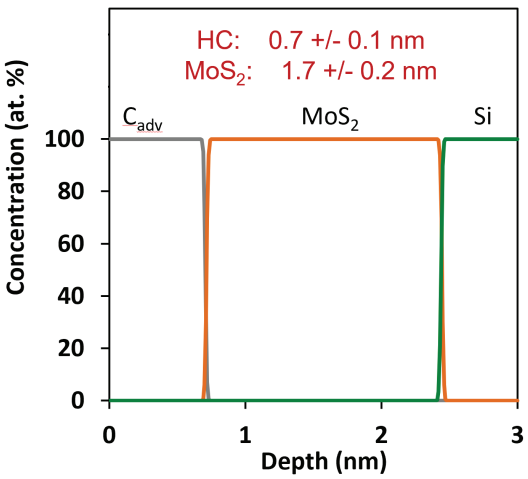


# *Strata*PHI 2.0 Applications and Features

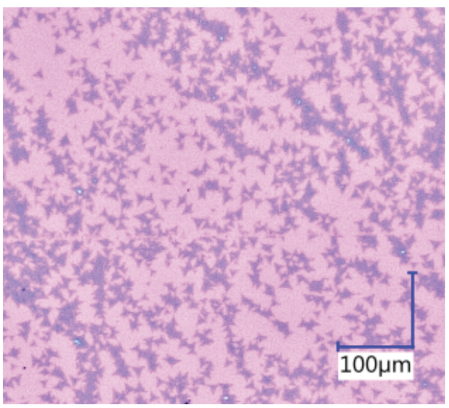
- Non-destructive multi-layer thin film thickness and composition (depth profile)
- High-throughput metrology tool - automated data file handling and calculations
- Surface coverage in atoms/cm$^2$ from XPS and HAXPES data
- Adventitious carbon thickness
- Combines XPS and HAXPES spectra in a single analysis for thickness of layers of various thicknesses
- Built-in database editor for material properties and attenuation lengths (ALs)
- User-defined recipes can be saved and invoked for consistent treatment of multiple data sets for metrology and other applications
- *Strata*PHI processing recording (SPR) file tracks model setup and saves optimized structure for future analysis and sharing among users
- Automated logging capability with export to Excel™, PowerPoint™, text files, and processing record files
- Very fast calculation - less than 0.2 seconds
- Works with data from all Physical Electronics XPS instruments
- Creates ANG and PRO files from individual SPE files

## Fractional Coverage Analysis

**_Strata_PHI**
**$MoS_2$ Fractional Coverage: 31%**

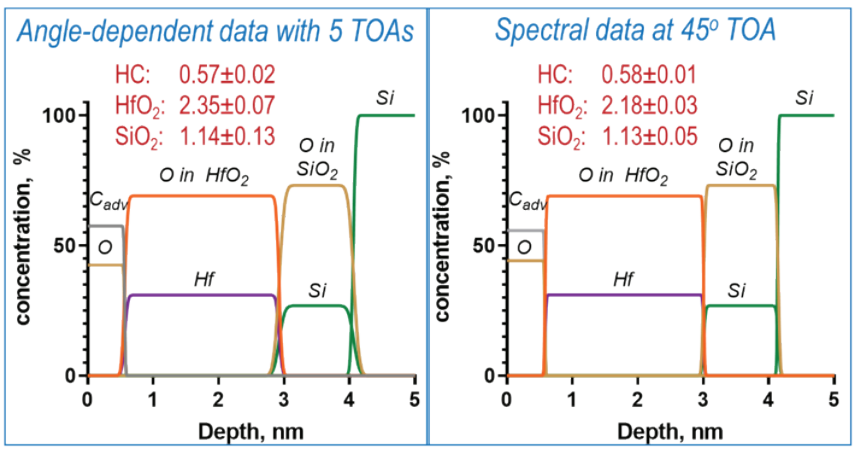


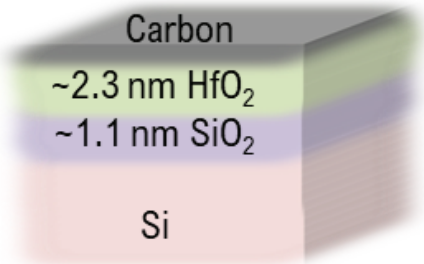

**Optical Microscope**
**$MoS_2$ Fractional Coverage: 35%**




*Strata*PHI allows calculation of fractional coverage. Thickness and coverage of partially-covered $MoS_2$ flakes were calculated from multiple take-off angles in *Strata*PHI 2.0. Calculated coverage is very close to that determined with an optical microscope.

## Single Take-OFF Angle (TOA) Analysis




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.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