SYNOPSYS®

DATASHEET

S-Litho PWA Ultra

Process Window Analysis

Comprehensive metrology data assessment for efficient modeling data preparation and process characterization

Sentaurus Lithography PWA Ultra (S-Litho PWA Ultra) is a comprehensive and powerful tool for process window analysis. Lithography process engineers use it to assess and visualize critical dimension (CD) metrology data. S-Litho PWA Ultra determines key measures that characterize the performance of the lithographic process, such as process window size or exposure latitude. Multiple datasets are analyzed individually, and the overlapping (or common) process window is determined.

Moreover, S-Litho PWA Ultra supports the review of metrology data such as scanning electron microscope (SEM) images within layout context by enabling the visualization of results within Synopsys' layout viewer and editor tool, IC WorkBench and Proteus WorkBench. Measured contours can be overlaid with simulated contours and layout data to compare results. S-Litho PWA Ultra also supports the direct extraction of CD and contour information from SEM images to supplement metrology data, independent of the equipment vendor's data processing.

Applications

S-Litho PWA Ultra is a general-purpose tool that can analyze any multidimensional matrix of observations as a function of two parameters. These observations (input data) are usually CDs of a series of features – measured or simulated – as a function of exposure dose and defocus (deviation from a nominal focus position). Other typical indicators can be sidewall angles of resist profiles or resist thickness loss. Figure 1 shows the graphical user interface. A hierarchical tree of all imported datasets allows selecting, sorting, grouping, or filtering of data. Various chart types can be used to visualize the input data as well as the analysis results.

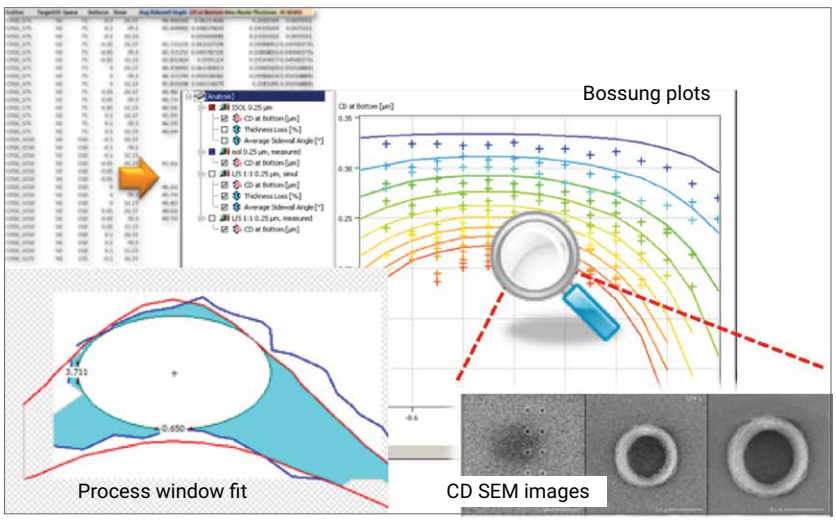

Figure 1: Focus-exposure matrix visualization including modeling, associated SEM images for a selected data point, and overlapping process window results

CD SEM metrology data can be directly imported into S-Litho PWA Ultra. Hitachi's mrs file format as well as Applied Material's cst file format are supported. If available, the associated SEM images for each measurement point can be loaded as well.

Based on input metrology data, S-Litho PWA Ultra determines process performance indicators, such as process latitude or process window size. Rectangular or elliptical fits facilitate the comparison of process windows obtained under different process conditions, and allow to report and document lithography process performance. If multiple datasets are loaded, the application can determine the overlapping process window for a selected series of data.

Although the CD is the most commonly used parameter, almost any evaluation result can be used for process window analysis; resist loss and the sidewall angle of a resist profile are other typical analysis parameters.

The visualization and statistical analysis of experimental CD metrology data is a key application within PWA. Dedicated features for data-smoothing are useful to reduce data volume or to remove measurement noise. Additional functionality is available to eliminate invalid data or to apply weights to individual data points, supporting the data preparation for subsequent tasks such as the calibration of rigorous or compact resist models.

Layout Centric SEM Data Analysis

The detailed analysis of SEM images requires background information about the initial target mask layout. S-Litho PWA Ultra provides an interface to Synopsys layout viewing and editing tools such as IC WorkBench and Proteus WorkBench in order to review images and extracted contours within their layout context (Figure 2). Process engineers can evaluate metrology data more easily and identify outliers.

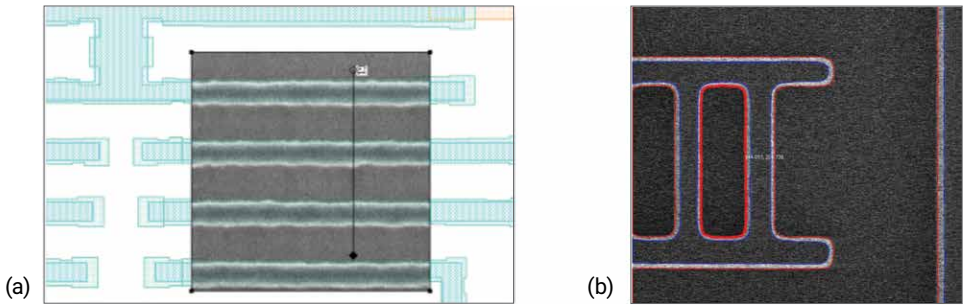

Figure 2: (a) Layout clip in Proteus WorkBench overlaid with SEM image through interface with S-Litho PWA Ultra
(b) SEM images with extracted contour (red = bottom contour)

Extracted contours can be further analyzed with respect to their CDs, or compared to simulated contours generated by rigorous or compact models. The environment provides comprehensive functionality to verify SEM results through cross correlation.

In addition, S-Litho PWA Ultra provides a link to the remaining Sentaurus Lithography (S-Litho) tool family for processing any simulated lithography evaluation results efficiently. Together with the WorkBench interface of S-Litho, metrology results can be analyzed in more detail by comparison against rigorous simulation results and 3D visualization.

Access S-Litho rigorous simulation results for extended analysis and 3D visualization

More complex tasks or the integration into flows can be easily realized through automation and scripting, as all features of S-Litho PWA Ultra are supported through API commands.

For more information about the Sentaurus Lithography product family and other Synopsys products, support services, or training, go to synopsys.com/silicon.html