



## Thin Film Acquisition/Analysis

### Probe for EPMA Thin Film Acquisition and Analysis

Probe for EPMA provides optimized capabilities for rapid and automated acquisition and accurate quantitative analysis of thin film materials on electron opaque substrates (and unsupported films).

By utilizing Multi-Voltage-Analysis (MVA), Probe for EPMA can automatically acquire multiple data sets at optimized electron beam energies to simultaneously determine both thickness and composition in thin film materials of all compositions and thicknesses.

The screenshot shows the following settings in the software:

- Select Multiple Voltage Samples (multi-select):** A list of samples is shown, with 'Un 38 8-NiWB-Co' selected. Below the list, 'Standards' and 'Unknowns' radio buttons are present, with 'Unknowns' selected. A note states: 'Select a group of samples that represent a single analysis position acquired at multiple voltages for thin film processing by the StrataGem thin film software. Then click the Output button. Repeat for each group of multiple voltages.' Below this, sample details are shown: 'Un 38 8-NiWB-Co', 'TO = 40, KeV = 18, Beam = 20, Size = 0', '(MagAnal = 4000.), Mode = Analog Spot', '(MagDef = 0, Magmag = 100)', 'Image Shift [X,Y]: 0, 0'.
- Sample Conductive Coating:** Includes 'Include Conductive Coating On Unknown' checkbox. A table shows Element 'c', Density '2.1', and Thickness (A) '200'.
- Sample Description:**
  - 'Include Sample Description For Unknown' checkbox is checked.
  - 'Homogeneous Layer Model' is selected. A table shows Element (multi) 'co ni cu ti w si p', Density '5', and Thickness (A) '100'. A note explains: 'Select the homogeneous or replicate layer model. If homogeneous, then select (using multi-selection) all the elements in the homogeneous layer along with the density and thickness. If Replicate, then select (in the lower section) each element to be replicated assuming a pure element and an unknown thickness.'
  - 'Include Silicon In The Layer' checkbox is unchecked.
  - 'Replicate Layer Model' and 'Use Known Thickness' options are present.
  - A table lists elements with their densities and thicknesses:
 

| Element | Density  | Thickness (A) | Use                                 |
|---------|----------|---------------|-------------------------------------|
| b       | 2.34     | 100           | <input checked="" type="checkbox"/> |
| o       | 0.001429 | 100           | <input checked="" type="checkbox"/> |
| co      | 8.9      | 100           | <input type="checkbox"/>            |
| ni      | 8.9      | 100           | <input type="checkbox"/>            |
| cu      | 8.96     | 100           | <input type="checkbox"/>            |
  - 'Number of Replicate Layer Repeats' is set to '10'.
- Output Options:**
  - 'Output All Data Points (confirm import in StrataGem)
  - 'Output Averaged K-ratio Data Only'
  - 'Output Each Data Point To Separate File (for statistics)
  - 'Skip All K-ratios That Are Less 0.0002 (0.02%)
  - 'Set K-ratios <= 0.0002 to a Value Of 0.0002 (0.02%)
  - 'Do Not Output Standard Compositions To Output File'
- Standard Conductive Coating:**
  - 'Include Conductive Coating On Standards' checkbox is checked.
  - A table shows Element 'c', Density '2.1', and Thickness (A) '200'.
- Substrate Description:**
  - 'Element' is 'si'.
  - 'Output Substrate As An Oxide' checkbox is unchecked.
  - 'Standard' is '1 Schott Cover Slip Glass [D 263]'.

Based on work by Pouchou and Pichior, this robust and flexible MVA method even allows for the accurate determination of multiple layers on substrates with excellent accuracy. Due to the superb sensitivity of EPMA, film thicknesses down to a few nanometers can be also characterized with confidence. In cases where the same element is present in both the film and substrate, e.g., Si/Ge on Si wafers, this method can be combined with x-ray reflectivity (XRR) to robustly determine the unknown composition even on complex and insulating substrates such as Dow 1737 FPD glass.