



SEM Lab, Inc. provides ...

Technical consulting services

Failure analysis services

Scanning electron microscopy (SEM) services

... with a focus on electronic materials and processes

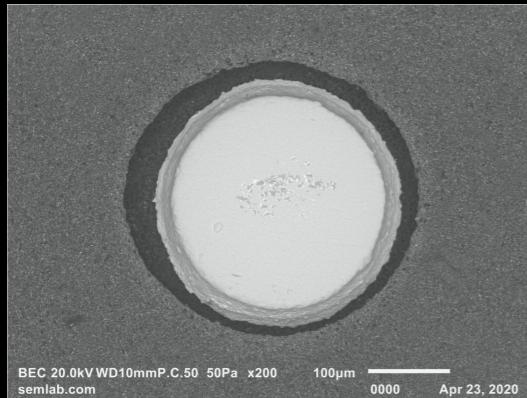
ENIG Gold Thickness

**Estimate gold thickness on ENIG finished PWB
features based on ZAF quantification of EDS data?**

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BSE SEM image

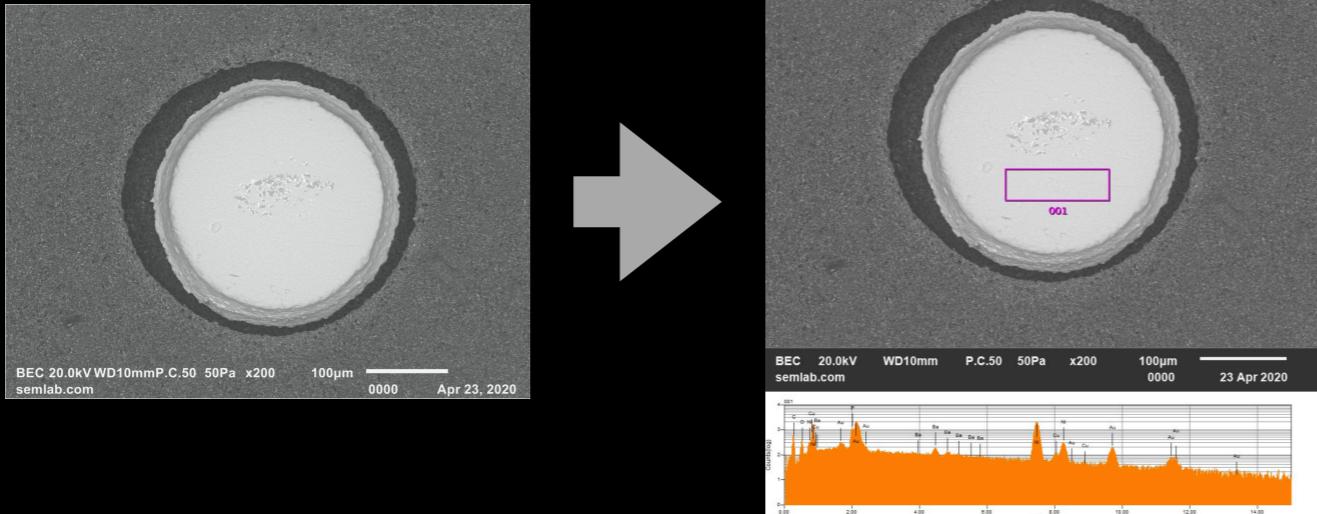


ENIG Gold Thickness

Estimate gold thickness on ENIG finished PWB features based on ZAF quantification of EDS data?

EDS raster scan & spectrum

BSE SEM image

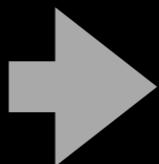
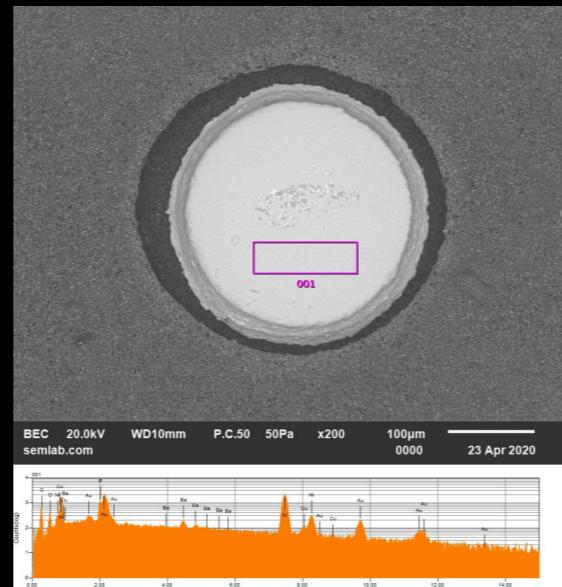
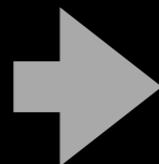
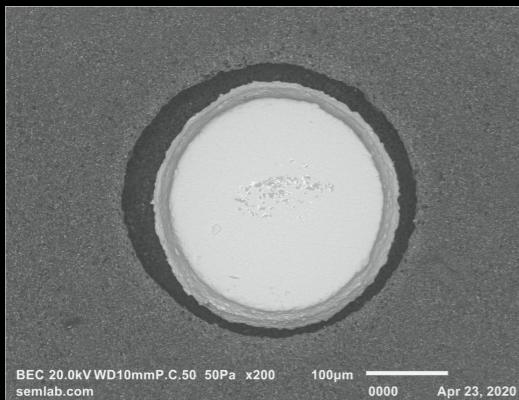


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Quantified EDS data

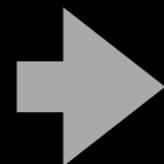
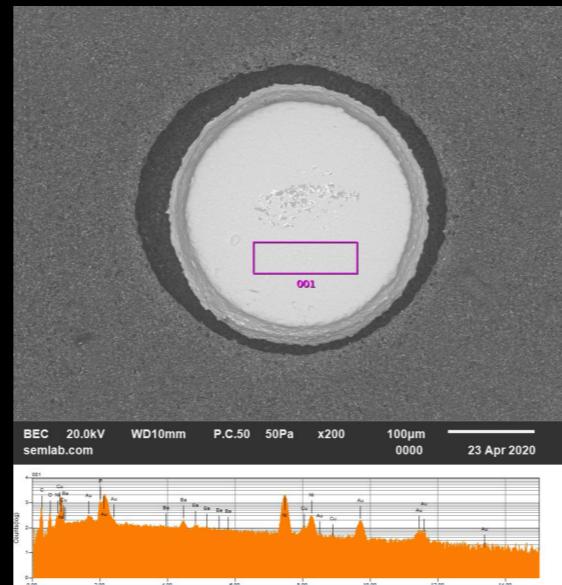
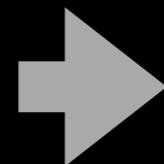
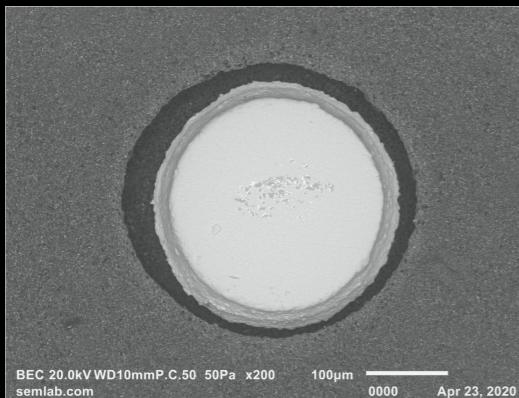
Formula	mass%	Atom%
C	3.72	37.74
O	0.97	7.35
P	1.75	6.88
Ni	18.84	39.12
Cu	0.64	1.23
Ba	0.89	0.79
Au	11.12	6.88
Total	37.92	100

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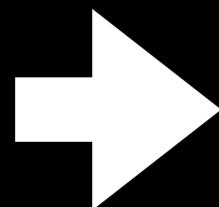
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ENIG Gold Thickness = 0.103 microns
wt% P in EN = 8.5%

ENIG Gold Thickness

Tool Development ...

- **Python 3.13.2**
- **Scientific Computing: NumPy, SciPy**
- **Data Processing: Pandas**
- **User Interface: Streamlit**
- **Physics: XrayLib**

ENIG Gold Thickness

User Interface ...

The screenshot shows a web-based application for calculating thin-film thickness. On the left, a sidebar titled "Run Fit" contains fields for "Preset stack" (set to "ENIG_Au_on_NiP_..."), "Elements of interest (used in SSE)" (set to "No options to select"), and "Weights (optional)". A red "Run Fit" button is at the bottom. The main area is titled "EDS Thin-Film Thickness (20 keV)" and includes instructions: "Paste ZAF-quantified EDS tables → select stack → choose elements of interest → fit thickness.". Below this is a "Paste ZAF table (CSV or whitespace)" input field with a "Parse → DataFrame" button and a "Clear" button. A sample ZAF table is shown in the input field:

Element	mass%	Atom%	Sigma	Net
Al	14.6	18.8		
Si	10.3	12.7		

At the bottom, a note states: "Assumptions: 20 keV ZAF quantification; selected elements are normalized to 100% before fitting. NiP density & composition follow your law: $\rho = -10 \cdot \text{wt\%P} + 8.9$, $\text{wt\%P} = P/(Ni+P)$. Densities & stoichiometries come from presets unless overridden by NiP rule."

ENIG Gold Thickness

Simply paste EDS data here ...

The screenshot shows a user interface for calculating thin-film thickness. On the left, there's a sidebar with 'Run Fit' options, including a dropdown for 'Preset stack' set to 'ENIG_Au_on_NiP_...', a dropdown for 'Elements of interest (used in SSE)' showing 'No options to select', and a 'Weights (optional)' button. A prominent red 'Run Fit' button is at the bottom of this sidebar. The main area has a title 'EDS Thin-Film Thickness (20 keV)' and instructions: 'Paste ZAF-quantified EDS tables → select stack → choose elements of interest → fit thickness.' Below this is a section titled 'Paste ZAF table (CSV or whitespace-delimited)' with a 'Paste here' input field containing the following EDS data:

Formula	mass%	Atom%
C	3.72	37.74
O	0.97	7.35
P	1.75	6.88
Ni	18.84	39.12
Cu	0.64	1.23
Ba	0.89	0.79
Au	11.12	6.88
Total	37.92	100

Below the input field are two buttons: 'Parse → DataFrame' and 'Clear'. At the bottom of the main area, a note states: 'Assumptions: 20 keV ZAF quantification; selected elements are normalized to 100% before fitting. NiP density & composition follow your law: $\rho = -10 \cdot \text{wt\%P} + 8.9$, $\text{wt\%P} = P / (\text{Ni} + \text{P})$. Densities & stoichiometries come from presets unless overridden by NiP rule.'

... and press parse button

ENIG Gold Thickness

Select elements e.g. Au, Ni, P ...

The screenshot shows a software interface for material analysis. On the left, a sidebar titled "Run Fit" contains a "Preset stack" dropdown set to "ENIG_Au_on_NiP..." and a "Elements of interest (used in SSE)" section with checkboxes for P (checked), Ni (checked), and Au (checked). Below these are buttons for "Weights (optional)" and a red "Run Fit" button. In the center, a "Parsed Table" displays elemental composition:

Formula	mass%	Atom%
C	3.72	37.74
O	0.97	7.35
P	1.75	6.88
Ni	18.84	39.12
Cu	0.64	1.23
Ba	0.89	0.79
Au	11.12	6.88
Total	37.92	100

Below the table, a note says "NiP updated from measured Ni/P → wt%P=8.50%, ρ_NiP=8.050 g/cm³". Another note states "Selected elements sum to 83.60% → normalized to 100% for fitting".

On the right, there are sections for "Thickness (nm)", "Residuals (wt%)", and "SSE". The "Thickness (nm)" section shows JSON data for Au and NiP thicknesses. The "Residuals (wt%)" section shows JSON data for residuals of P, Ni, and Au. The "SSE" section shows a value of "0.000000".

... and press <Run Fit> button

ENIG Gold Thickness

Future development ...

- add module for Al/Ti-W/SiO₂/Si₃N₄ on semiconductors
- add module for optical coatings on SiO₂
- add module for user customized stacks



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