APVERION
BRINGING ENGINEERING KNOWLEDGE INTO FOCUS

FIELD NOTE 02 / TEM / STEM

Resolve the structure.

Protect the interpretation.

A site-specific workflow for translating a nanoscale question into a representative lamella, fit-for-purpose imaging and spectroscopy, and a conclusion connected to thickness, orientation, preparation, and analytical limits.



01	02	03	04	05	06
DEFINE	CORRELATE	PREPARE	SURVEY	ACQUIRE	INTERPRET

01 Define

Translate the engineering hypothesis into the exact interface, layer, defect, chemistry, orientation, and spatial resolution required.

EVIDENCE TO PRESERVE

- Target mechanism and alternatives
- Required field of view and resolution
- Analytical success criteria

DECISION GATE

Does TEM/STEM answer a question that broader methods cannot?

02 Correlate

Use prior optical, SEM, EDS, electrical, layout, and process evidence to lock the target and representative context.

EVIDENCE TO PRESERVE

- Correlative image stack
- Target coordinates and orientation
- Population and sampling rationale

DECISION GATE

Is this lamella representative of the claimed mechanism?

03 Prepare

Deposit protection, extract the site-specific lamella, attach, thin, clean, and document every geometry or beam-condition change.

EVIDENCE TO PRESERVE

- Lift-out location and orientation
- Thickness trajectory and beam history
- Protection, attachment, cleaning details

DECISION GATE

Is the region intact, stable, and electron transparent?

04 Survey

Begin at low dose and broad field of view to assess thickness, bending, contamination, damage, interfaces, and usable analytical regions.

EVIDENCE TO PRESERVE

- Low-magnification context
- Thickness and artifact assessment
- Selected analytical regions of interest

DECISION GATE

Which regions can support reliable high-resolution analysis?

05 Acquire

Apply BF/DF TEM, HAADF-STEM, diffraction, EDS, or EELS according to the hypothesis - not simply instrument availability.

EVIDENCE TO PRESERVE

- Mode, voltage, dose, convergence, dwell
- Calibration, drift, thickness, and ROI
- Raw images, spectra, maps, processing history

DECISION GATE

Are signal, dose, and spatial resolution fit for the claim?

06 Interpret

Separate observation from mechanism, compare alternatives, state confidence, and connect nanoscale findings to device and process context.

EVIDENCE TO PRESERVE

- Observed features vs interpretation
- Artifact controls and analytical limits
- Conclusion, confidence, and next test

DECISION GATE

Would an independent reviewer reach the same evidentiary boundary?

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THE DURABLE ENGINEERING RECORD

What should survive *after the work is complete.*

01	Hypothesis and method-selection rationale
02	Correlative target record
03	Lamella location, orientation, and thickness history
04	Raw TEM/STEM, diffraction, EDS, and EELS data
05	Calibration and processing provenance
06	Artifact analysis, confidence, and limitations

01 **DEFINE** — *02* **CORRELATE** — *03* **PREPARE** — *04* **SURVEY** — *05* **ACQUIRE** — *06* **INTERPRET**

COMMON KNOWLEDGE FAILURES

The instrument can succeed *while the record fails.*

01 Using the highest resolution available without proving that the sampled site is representative.

02 Losing the relationship between lamella orientation and device or process geometry.

03 Interpreting mass-thickness, diffraction, preparation damage, or contamination as chemistry.

04 Publishing processed images without raw data, calibration, acquisition, and processing history.

OPERATING PRINCIPLE

Atomic-scale resolution does not remove uncertainty. It makes preparation history and acquisition context more important.

What evidence would prove that the observed feature belongs to the sample - and not to the preparation?