F1-GIF System

Model 1169

As materials challenges become more complex, researchers can no longer afford to compromise between range, resolution, dose, or workflow efficiency. Built for scientists pushing the boundaries of discovery, the F1-GIF™ System delivers complete chemical and structural insight in a single electron energy loss spectroscopy (EELS) platform, accelerating breakthrough research and inspiring a new era of materials science without compromise.

Benefits

- **Simultaneously captures range and resolution without trade-offs** – Captures broad energy ranges and fine spectral detail in one acquisition, eliminating the need to choose between coverage and precision.
- **Sees the full elemental picture** – Resolves multiple edges with the clarity needed for confident chemical identification across complex, multi-element materials.
- **Operates seamlessly across accelerating voltages** – Uses one large-format direct detection platform for low- and high-kV analysis from 30 – 300 kV.
- **Faster answers with less sample damage** – Uses direct detection and dose fractionation to collect rapid frames, sum signal, correct drift, and preserve sensitive specimens.
- **Unified, multidimensional analysis** – Correlates EELS with 4D STEM for a 5D STEM workflow that connects composition, chemical state, structure, orientation, strain, and local potential.

At the heart of the F1-GIF system is the ability to eliminate the traditional trade-off between energy range and energy resolution.

Researchers can capture the full elemental picture—from light to heavy elements—in a single acquisition, avoiding the multiple energy range exposures that increase dose, acquisition time, and sample damage.

Leveraging a new generation large-format 5,760 x 4,096-pixel direct detection sensor and advanced electron optics, the system delivers more than 4,000 eV of energy range with sub-1 eV/channel sampling, providing broad spectral coverage and high-resolution detail simultaneously. The result is greater sensitivity to subtle chemical signatures, improved detection of trace elements, and deeper insights with greater confidence and efficiency.

The F1-GIF system further extends analytical capability by delivering uncompromised performance across the full accelerating voltage range from 30 – 300 kV.

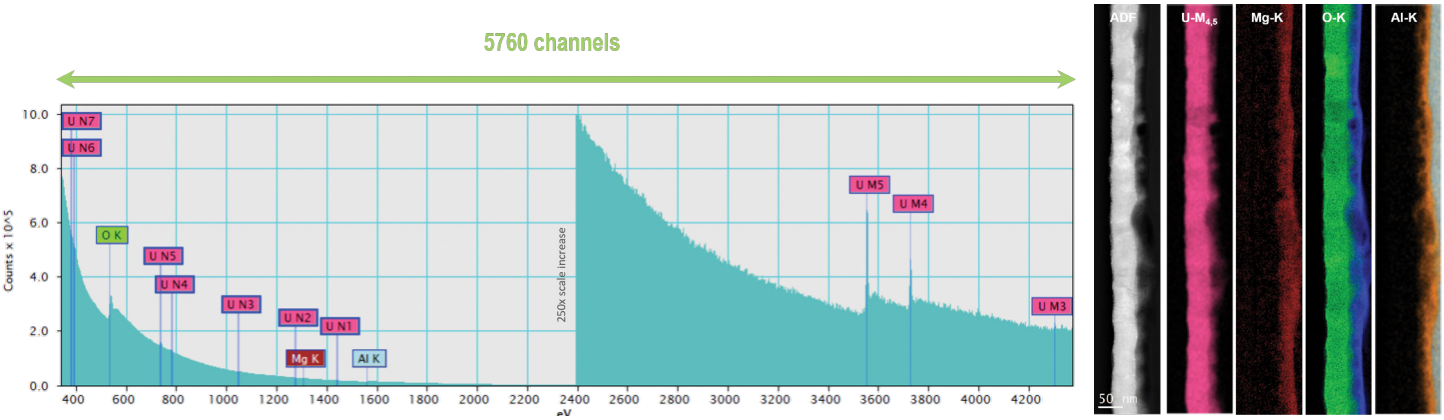

Figure 1. F1-GIF system lets you see the full spectrum. In this example, a post-annealed uranium oxide (UO_2) film on an aluminum substrate was analyzed. UO_2 spans widely separated elemental edges (U, O, Mg, Al), which requires broad spectral coverage while maintaining resolution for accurate chemical identification. Traditional sensors require multiple exposures to see the full elemental picture at cFEG resolution; F1-GIF only requires one. Sample courtesy Prof. Manukyan, Notre Dame. *J. Phys. Chem. C* 2023, 127, 9850–9857

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As advanced materials and next-generation semiconductor devices become increasingly small, complex, and beam sensitive, researchers often need to operate at lower voltages without sacrificing analytical performance. A purpose-built direct detection sensor combined with a breakthrough prism architecture enables broad energy coverage, sharp spectral resolution, and exceptional sensitivity at any voltage, allowing researchers to preserve delicate samples while capturing more elemental information in a single experiment.

Beyond conventional EELS, the F1-GIF system integrates high-speed dose fractionation, low-dose spectrum imaging, and synchronized 5D STEM workflows into a unified platform. Researchers can correlate chemistry, bonding, structure, orientation, strain, and electrostatic behavior from the same nanoscale region while minimizing beam-induced damage.

By combining direct detection with a fundamentally new spectrometer design, the system delivers ~2x higher signal-to-noise ratio, improved charge collection, enhanced point spread function, effectively zero false counts, over 2x higher EELS collection area, and an over 2x larger imaging field of view. The result is richer multimodal datasets, more reliable characterization of complex materials, and faster, more confident scientific discovery.

Specifications

Operating range (kV)	30 – 300
Imaging size (pixel x pixel)	5,760 x 4,096
EELS energy channels (pixels)	5,760
Dispersion at 4,000 eV energy range (eV/channel)	0.7
Detector technology	Radiation hard CMOS, direct detection, counted
Detector frame rate (fps)	
Full-frame to memory	>150
Sub-area (*in-situ* option)	>3,500
Spectroscopy	>10,000

* *In-situ* spectrum imaging and 4D STEM modes require optional hardware

Ordering

Model	Description
1169	F1-GIF System

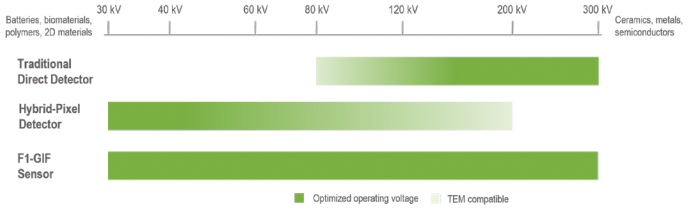

Figure 2. The F1-GIF is the only energy filter that unifies performance across all voltages (30 – 300 kV). Leveraging large-format counting direct detection at every voltage, it achieves reliable, high-sensitivity results without compromise at any accelerating voltage.

Applications

- Advanced semiconductor and device analysis
- Beam-sensitive and low-dose materials research
- Batteries, biomaterials, polymers, and 2D materials
- Oxides, ferroelectrics, catalysts, and quantum materials
- Chemical bonding and ELNES fine-structure analysis
- Correlative 5D STEM investigations

Other products to consider

- STEMx® System
- STEMx OIM
- STEMPack™ Spectrum Imaging

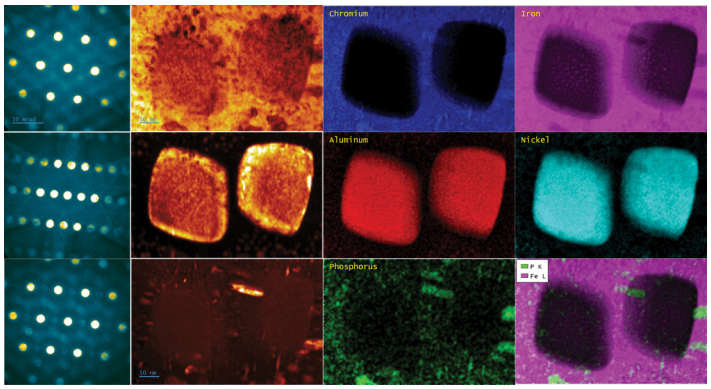

Figure 3. 5D STEM data analysis from coherent Ni/Al and smaller (Cr,Mo)2P precipitates in a Fe/Cr matrix. (Left) Diffraction extracted from 4D STEM dataset. (Center left) virtual aperture dark-field images generated from the dataset. (Right) Composition maps extracted from the sequentially acquired EELS spectrum images. EDS data (not shown) was jointly acquired with both the 4D STEM and the EELS acquisitions. F1-GIF incorporates advanced workflows, such as this 5D STEM workflow to automate the collection of EELS, EDS, and energy-filtered 4D STEM data.

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