Commercial Release of a Ta-based Superconducting Tunnel Junction X-ray Detector for Synchrotron Science

Poster 3.32

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Detector for Partial Fluorescence Yield
X-ray Absorption Spectroscopy (PFY-XAS)

Detector parameters:
- Energy range: 100 – 2000 eV
- Resolution: differentiate all lines (< 10 eV)
- Speed: ability to handle high flux beamlines that produce $10^{12}$ photons/sec

Needs for Commercialization:
- Automated Cooldown to ~0.1 K
- Computer-controlled STJ biasing
- Compatible with different endstations
- Reliable, large duty cycle
Cryostat: 2 versions to match needs
Source-limited performance

\[ \Delta E_{FWHM} = 2.355 \sqrt{\varepsilon E_x \left( F + 1 + \frac{1}{\langle n \rangle} \right)} \]
High efficiency through high count rates

![Graph showing energy (eV) on the x-axis and counts/eV on the y-axis. The graph includes a inset showing FWHM (eV).]

![Graph showing count rate (counts/sec/array) on the x-axis and resolution (eV) at 525 eV on the y-axis.]

Count Rate (counts/sec/array)

Count Rate (counts/sec/pixel)
Increased sensitivity for PFY-XAS

Primary competitor: Si drift detectors

STJ has lower background, higher discrimination for sensitive measurements.
### CRYO-ELECTRONICS

#### Superconducting Tunnel Junction Detectors

We have developed high-resolution energy-dispersive X-ray spectrometers based on 3\textdegree superconducting tunnel junctions (STJ) for transmission electron microscopy (TEM), electron spectroscopy for chemical analysis (ESCA), and energy-dispersive X-ray diffraction (EDXD). The detectors consist of an array of STJ diodes, each individually controlled by a preamplifier, resulting in a detector with high intrinsic resolution and high efficiency. The energy range is from 2.5 to 260 eV, with a peak throughput of 1.25 MeV h\(^{-1}\) at 100 eV.

- **Performance Characteristics**
  - High energy range: 2.5 to 260 eV
  - Peak throughput: 1.25 MeV h\(^{-1}\) at 100 eV
  - High resolution: 9000 at 25 eV

#### STJ-X-Ray Spectrometer

The spectrometer is designed for high-resolution, high-throughput X-ray analysis. It features a compact, digitally-controlled preamplifier system specifically for STJ detectors. The spectrometer is equipped with a 32-mm diameter, 1.5-meter-long detector, which provides a high degree of energy resolution and high detection efficiency. The spectrometer is equipped with a high-performance, computer-controlled spectrometer and a dedicated software package for data analysis.

- **Performance Characteristics**
  - Detector size: 32-mm diameter, 1.5-meter-long
  - High resolution: 9000 at 25 eV
  - High detection efficiency: 90%

#### High-Resolution X-Ray Spectroscopy

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#### User-Friendly Liquid-Cryogenic-Free Cryostat

The cryostat is designed for high-resolution, high-throughput X-ray analysis. It features a compact, digitally-controlled preamplifier system specifically for STJ detectors. The cryostat is equipped with a 32-mm diameter, 1.5-meter-long detector, which provides a high degree of energy resolution and high detection efficiency. The cryostat is equipped with a high-performance, computer-controlled spectrometer and a dedicated software package for data analysis.

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#### Higher Sensitivity for PF/SAS

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