



**SIGRAY**

# Sigray FFAST-MS™

HIGH BRILIANCE X-RAY MICROFOCUS SOURCE

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Patented X-ray Technologies  
US Patent 10,658,145 B2 - High brightness x-ray reflection  
source



US10658145B2

(12) **United States Patent**  
**Yun et al.** (10) **Patent No.:** US 10,658,145 B2  
(45) **Date of Patent:** May 19, 2020

(54) **HIGH BRIGHTNESS X-RAY REFLECTION SOURCE**

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(\* \*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 16/518,713  
(22) Filed: Jul. 22, 2019

(65) **Prior Publication Data**  
US 2020/0035440 A1 Jan. 30, 2020

**Related U.S. Application Data**

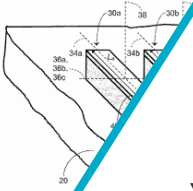
(60) Provisional application No. 62/703,836, filed on Jul. 26, 2018.

(51) **Int. Cl.**  
**H01J 35/00** (2006.01)  
**H01J 35/12** (2006.01)  
(Continued)

(52) **U.S. Cl.**  
CPC ..... **H01J 35/12** (2013.01); **H01J 35/147** (2019.05); **H01J 35/153** (2019.05); **H01J 35/00** (2013.01);  
(Continued)

(58) **Field of Classification Search**  
CPC ..... H01J 35/12; H01J 35/153; H01J 35/147; H01J 35/00; H01J 2235/086; H01J 2235/081  
See application file for complete search history.

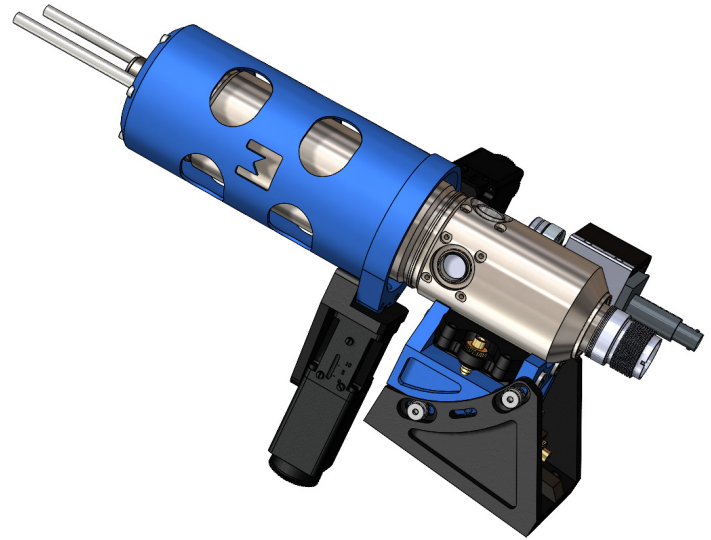
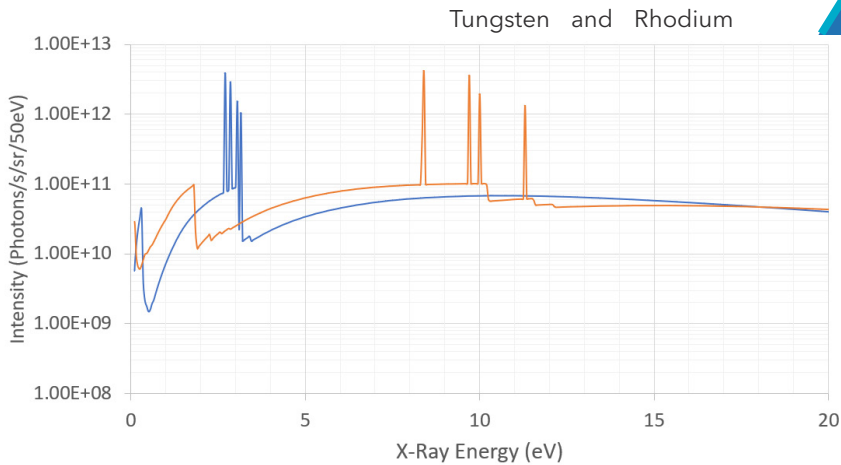
**Develop & upgrade**  
laboratory x-ray instruments  
with **Access to Multiple**  
**X-ray Spectra** within  
the same system



## FAAST-MS™ Source at a Glance

- » **Superior x-ray source and optic technology** with outstanding x-ray flux
- » **Multi-spectral source (MSS) target design** for user-selectable choice of multiple x-ray spectra, including access to novel characteristic energies
- » Optimized for microspot X-ray Analytical techniques: **enables high flux with a small spot size** for techniques such as microXRF, microXRD, XRM, and more

Left: Characteristic x-ray lines can comprise up to 95% of output by certain targets, enabling quasi-monochromatic illumination. Other times, such lines are undesirable (e.g., XAS) and complementary paired targets such as W/Rh can be used to avoid them. Bottom: FFAST-MS rendering.



## Designed for Pioneering Research & Central Labs Optimized for Demanding Applications with Diverse Analytical Needs

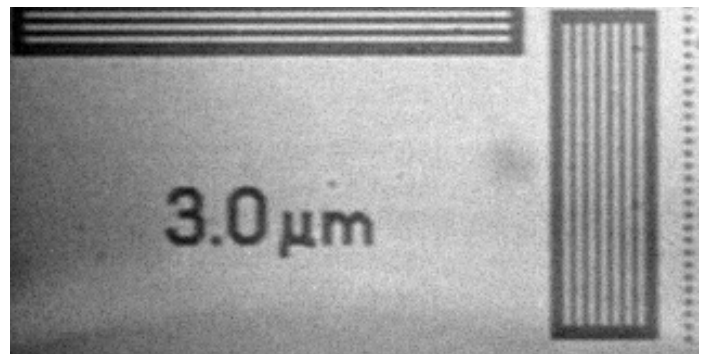
The FFAST-MS™ is a patented sealed tube x-ray source that enables access to high-flux, quasi-monochromatic x-rays and several selectable spectral characteristics due to the incorporation of multiple target materials.

### High Brightness X-ray Source with >10X Brightness

FFAST-MS™ features multiple x-ray target materials in close thermal contact with a diamond substrate. As one of the highest thermal conductivity materials in the world, diamond provides unique thermal advantages that allow substantially higher power loading for high flux and access to new x-ray target materials.

Benefits include:

- Multiple (up to 5) characteristic energies (e.g. Cr, Cu, Mo) for selection of optimal x-ray spectrum
- Rapid, push-button selection of x-ray energy (software-controlled movement between multiple x-ray targets)
- Small spot size with stable spot position
- No maintenance sealed source tube
- Long lifetime with up to thousands of target positions and robust dispenser cathode



**High Resolution:** Microfocus spot size for down to 3.0 micron resolution on a JIMA target.

# FAAST-MS™: Specifications

Parameter	Specification
<b>Source</b>	Sigray Patented Multi-target Source
Target Material	Multi Energy Option (Up to 5 customizable targets), e.g.: Si, Ag, Au, Cu, Cr, Mo, W, and more.
Min. Spot Size	6 - 20 $\mu\text{m}$
Target Substrate Material	Diamond
Maximum Power	100 W
Voltage	20 - 50 kV
Maximum Current	2 mA
<b>Accessories</b>	High Voltage Power Supply, Chiller, Ion Pump Controller

## Target Performance Examples

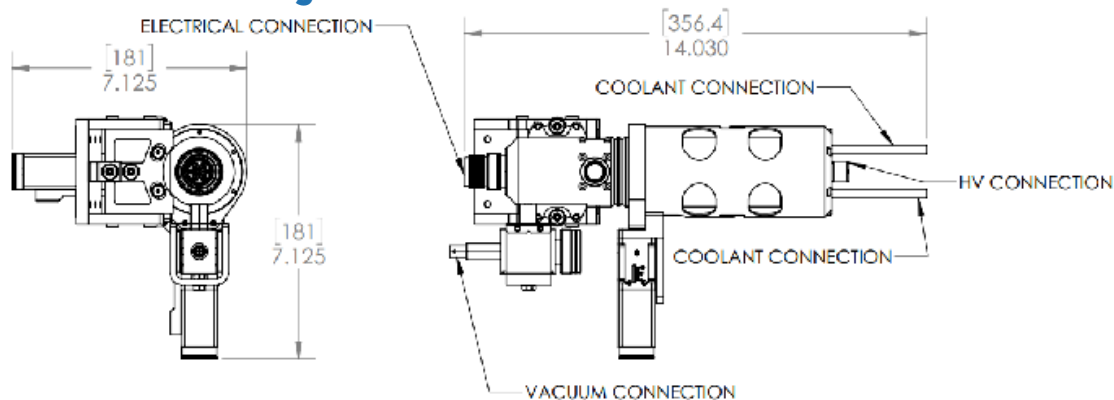
Element	X-ray Energy (keV)	Max Power <sup>1</sup> (W)	Spot Size <sup>2</sup> ( $\mu\text{m}$ )	Brightness <sup>3</sup> ( $\text{ph}/\text{mm}^2/\text{mrad}^2/\text{s}$ )
Copper	8.0	30	9	$6 \times 10^9$
Chromium	5.4	30	12	$4 \times 10^9$
Molybdenum	17.4	50	10	$2 \times 10^9$
Titanium	4.5	30	19	$2 \times 10^9$
Gold	9.7	20	9	$2 \times 10^9$
Silicon	1.7	50	19	$2 \times 10^9$
Cobalt	6.9	20	10	$4 \times 10^9$

1) Maximum power is given at maximum stability with a focused electron beam. Smaller spot sizes can be achieved with reduced power or some flux degradation at the max power listed. Larger spot sizes than shown provide even greater max power.

2) Spot size is measured as FWHM of the intensity distribution from a tungsten knife edge. Size given is at accelerating voltage value that maximizes characteristic emission vs Bremsstrahlung. Apparent spots may vary depending on viewing angle, may be asymmetric, and can vary per source.

3) Brightnesses quoted are attenuation-corrected emission of x-ray energy listed.

## Dimensions & Ratings



Source controlled remotely with software. Accessories include an ion pump controller

(5.6" x 3.5" x 9.9"), HV power supply, and a chiller (13" x 11" x 13")

Electrical Requirements: 110-240 VAC, 60 Hz

Operation: Suggested temp 20-25°C, max 85% relative humidity



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