

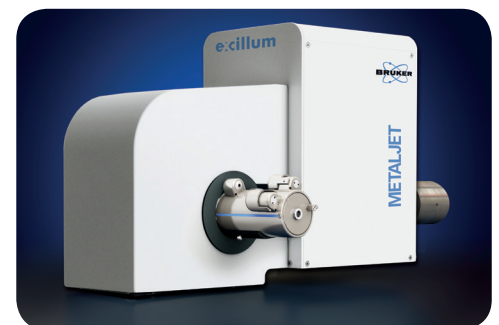


Product Sheet SC-XRD 49 **METALJET D2 PLUS – The Next Round of X-Ray Revolution**

- The Most Powerful Liquid Metal Jet X-ray Source for Chemical and Biological Crystallography

The world's strongest in-house X-ray source is now even more powerful: 250 W power load on the target, extended cathode lifetime with longer uptimes and further reduced maintenance requirements define the next generation, the new METALJET D2 PLUS.

The METALJET D2 PLUS was developed in collaboration with Excillum and finalized with Incoatec's dedicated HELIOS MX optics to deliver a small X-ray beam with the highest intensity, perfectly satisfying the ever-increasing demands of modern in-house crystallography.



Bruker METALJET X-Ray source

Most Advanced Technology at Your Service

Like traditional X-ray tubes, the METALJET D2 PLUS uses high-velocity electrons that collide with a metal target to generate X-rays. However, the solid anode of conventional X-ray tubes is replaced by a high-speed jet of liquid metal that can accept a much higher power load. Now operating at 250 W, the METALJET D2 PLUS produces an X-ray beam which is an order of magnitude brighter than traditional home sources.

Delivering such a small X-ray beam requires technical innovation in the design of the X-ray optics, since a smaller spot on the anode requires greater precision in the d-spacing of the multilayers. With improved deposition technology and higher precision that greatly enhance the optics' reflectivity, the HELIOS MX optics provide up to three times the intensity compared to conventional multilayer optics. The highly-monochromatic X-ray beam can easily be optimized to match the characteristics of each sample with a set of collimators that control beam size and divergence.

The METALJET D2 PLUS enables you to collect data on smaller, more weakly-diffracting crystals, improving productivity more than ever in the home lab.

The METALJET D2 PLUS continuously supplies fresh target material, ensuring constant intensity over time, different from rotating anodes, which quickly degrade in intensity due to anode roughening. The METALJET D2 PLUS is operated with single-phase power and also requires no external cooling, thereby minimizing installation requirements.

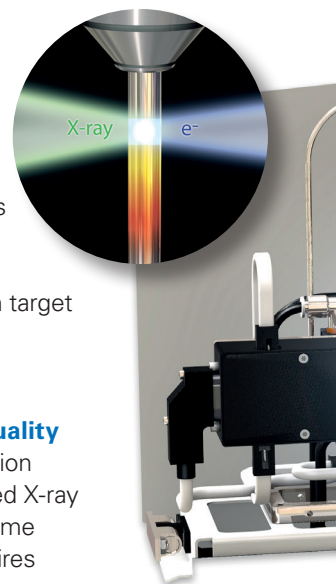
X-Ray Revolution without Rotation.

Higher Power Load

The brightness of traditional X-ray sources is limited by the anode's power loading capability. In conventional solid-anode technology, power loading is limited by the need to maintain the target's surface temperature well below its melting point in order to avoid damage to the target. In the METALJET D2 PLUS this limitation is removed by using a target that is already molten. The target is regenerative by nature, with the metal jet supplying fresh target material at a speed exceeding 50 m/s.

HELIOS MX for METALJET D2 PLUS – The Highest Level of Precision and Quality

For generating the best beam for diffraction from the best in-house source, specialized X-ray optics are essential. Preserving the extreme source brightness up to the sample requires X-ray optics of highest quality. More than a decade of experience in the field of synchrotron mirrors enabled us to develop synchrotron-class optics for a home-lab instrument. The HELIOS MX multilayer optics deliver up to three times the intensity of conventional multilayer optics. Improved deposition technology yields higher precision and greatly enhances the optics' reflectivity. Between Bruker and Incoatec, advancements in X-ray sources and optics always go hand in hand. For the METALJET D2 PLUS, we specifically developed unique low-figure-error optics. Patented optics are the only X-ray mirrors that fully preserve the inherent brilliance of the METALJET D2 PLUS. Beam properties of this first class X-ray component are opti-



Gallium: 'The Better Copper'

The METALJET D2 PLUS target is a gallium-rich ($K\alpha = 1.34 \text{ \AA}$) alloy with the $K\alpha$ emission line close to that of copper ($K\alpha = 1.54 \text{ \AA}$). Gallium provides the necessary diffraction spot spacing for accurate and reliable data reduction, yet the shorter-wavelength causes less radiation damage to the crystal, enabling high-multiplicity data sets to be collected.

The very small beam and gallium's shorter wavelength greatly improve the signal-to-noise ratio by reducing X-ray absorption by the sample, scattering by air and mother liquor as well as increasing detector sensitivity.



System integration – the key to best

We have designed the beam parameter of the METALJET D2 PLUS to best complement the focus of today's research. In the end, the METALJET D2 PLUS' extreme power and carefully designed HELIOS MX optics provide unprecedented brightness. The METALJET D2 PLUS, like the D8 VENTURE at the same high level, offers easy and stable downstream alignment, ensuring all system precision and minimized alignment aspects of the source operation, our short-term performance. Advanced hardware and component recognition ensure that the system integration makes the difference between Bruker and other sources.



Smaller Samples Require More Stable Systems

The D8 VENTURE's goniometer perfectly matches the small beam generated by the METALJET D2 PLUS; the smaller the beam, the more stable and accurate your entire experimental setup needs to be. The D8 VENTURE comes with all the features you need to make your experiment a success. All goniometer axes intersect within a sphere of just 7 micrometers. This ensures that the crystal always remains centered in the X-ray beam during data collection. Downstream alignment, established in all D8 VENTURE systems, allows easy alignment of the entire system. First the HELIOS MX optics are aligned with the source ensuring maximum intensity, and then the optimized beam is aligned with the goniometer center.

Easy, stable, and fast.

mized for the needs of structural biology with small, weakly diffracting and often quickly deteriorating crystals. Conversely, the relatively high figure error of inferior multilayer optics coupled with the METALJET D2 PLUS leads to a loss of brilliance of up to 70%.

HELIOS MX: the brightest optics under the sun.

Low maintenance for extended up-time

Maintenance of the METALJET D2 PLUS is straightforward and competitive with modern microfocus rotating anodes. Long intervals between scheduled maintenance guarantee extended instrument up-time. For peace of mind, cost efficient service and warranty extension options can be combined into packages exactly matching your needs. Newly introduced "Dynamic Adaptation Technology" delivers an even more stable X-ray beam with increased up-time and reduced service costs.

Best data quality

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the combination of the
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leads to an outstanding diffraction system with
ALJET D2 PLUS is seamlessly integrated with
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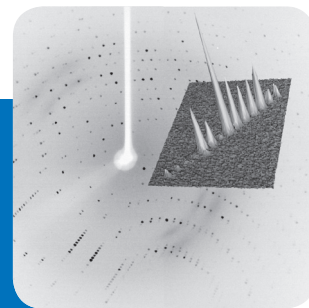


SAD Phasing

The crystal structure of Thaumatin from *Thaumatococcus daniellii* was determined by sulfur-SAD phasing methods using data collected on a D8 VENTURE diffraction system with the METALJET D2 PLUS X-ray source

Using one 100 micrometer crystal, a complete data set was collected to 1.65 Å in less than 3 hours. The experimental phases derived from the anomalous signal of the sulfur atoms allowed 95% of the protein backbone to be traced.

The successful phasing from a relatively low multiplicity data set highlights the very high quality of the Ga data and shows that S-SAD data can be collected in the home lab.



First in-house GPCR structure –Ox1R-StaR

G-protein-coupled receptors (GPCRs) are important for the pharmaceutical industry because more than 40% all prescription drugs target them. Normally, you would not associate GPCR projects with a home-lab system as these targets tend to form small and very weakly diffracting crystals. However, using the unique METALJET D2 PLUS and PHOTON detector combination, in-house data were collected on a GPCR target, for the first time matching previous synchrotron results.

660 Å unit cell axis in Ribosome

Not many PX labs regularly deal with axes of more than 350 Å. Nevertheless, long-axis projects demonstrate the outstanding capabilities of the D8 VENTURE with METALJET D2 PLUS and PHOTON detector. A 660 Å ribosome was successfully indexed based on two images collected at 0 and 90 degrees. The images show diffraction to better than 7.4 Å and a good separation of the spots. The D8 VENTURE comes with a set of two pinhole collimators allowing fast, reproducible adjustment of the X-ray beam divergence to the sample properties.

THE METALJET D2 PLUS Wrap-Up

Highest X-ray intensity due to exclusive patented liquid metal jet technology. The liquid target is able to accept power loads that are an order of magnitude larger compared to conventional rotating X-ray sources.

Unprecedented brightness resulting from the extremely high power load and smallest electron focus.

Perfect spot quality is achieved through the high-brightness LaB₆ cathode and smooth, self-regenerating, liquid metal target which provides exceptional spatial and emission stability.

Lower noise as the shorter-wavelength gallium K α X-rays result in reduced background scatter.

Lower running costs are ensured by the low power consumption, minimal cooling requirements, and the self-regenerating target.

Lower maintenance is achieved through the new Dynamic Adaptation Technology with a great design for serviceability and the use of best components with highest reliability.

Technical Specifications		Benefit
Cathode	High-brightness LaB ₆	Long lifetime, great stability
Target material ¹⁾	Gallium alloy	
Target type	Liquid jet	Ultimate brilliance for best data
Energy, wavelength, resolution	K α = 9.243 keV, 1.3414 Å, 0.67 Å	
Voltage	70 kV	
Power	250 W	Low power consumption, small ecologic footprint
Max current	4.3 mA	
Beam size at sample	< 100 μ m FWHM	Highest intensity on small, weakly diffracting samples
Flux density for samples < 50 μm	> 6 \times 10 ¹¹ X-rays/mm ² -sec	World's strongest in-house source
Mains, integrated with a D8 VENTURE	200 - 240 VAC (+6%, -10%), 1-phase, 50/60 Hz, 1 \times 32 A 200 - 208 VAC (\pm 10%), 1-phase, 50/60 Hz, 2 \times 40 A	Minimal pre-installation requirements
Cooling	Air-cooled	No external cooling required
Ambient temperature and humidity	20 - 25° C, 20% - 80% relative humidity (condensation not allowed)	
Target lifetime	> 8000 h, syringe refillable	No target deterioration, simple handling
Number of scheduled maintenance intervals per annum	2, due to Dynamic Adaptation Technology	Significantly reduced service costs

¹⁾ Room temperature liquid gallium alloy consisting of gallium and indium



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