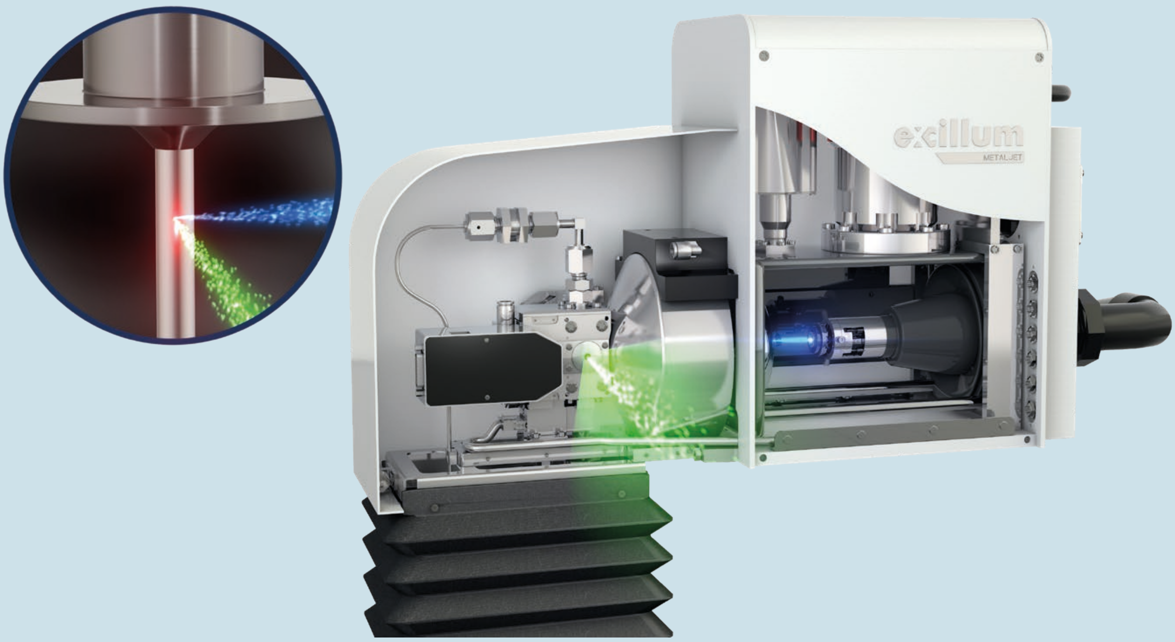
excillum

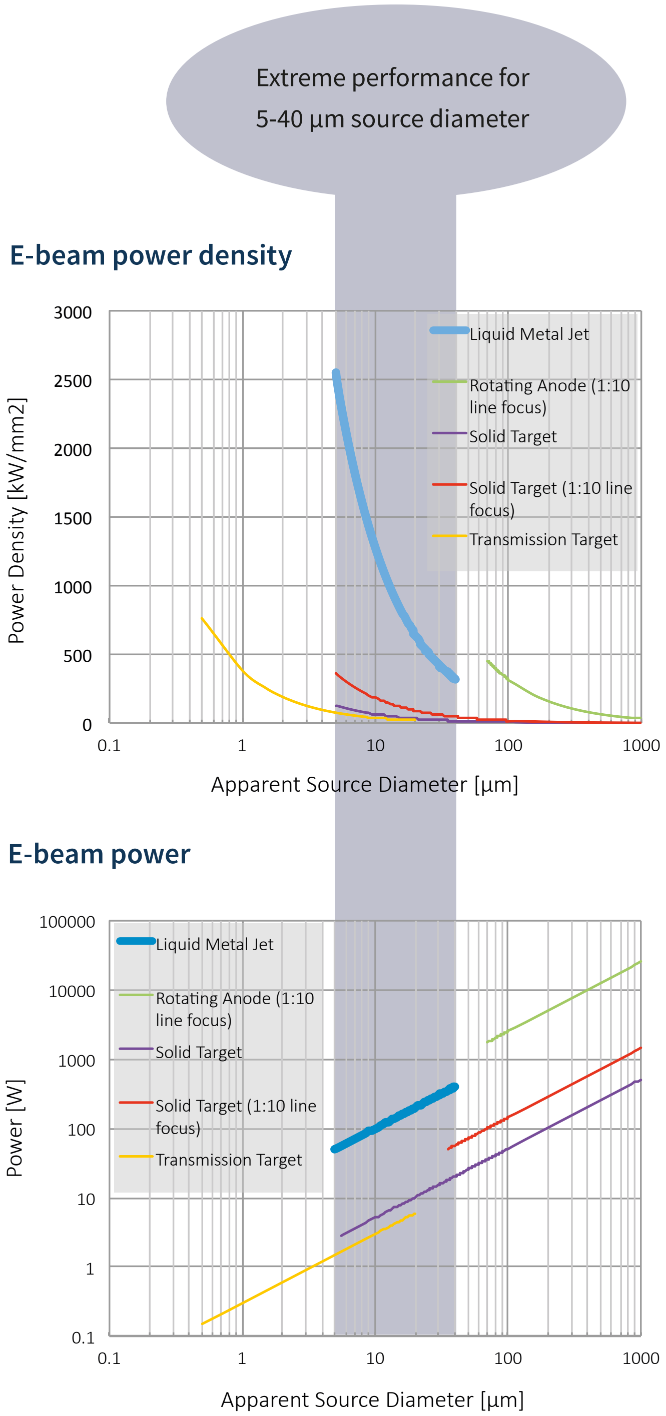
The MetalJet technology

Redefining the X-ray tube



The MetalJet concept

A conventional microfocus X-ray tube with the solid-metal anode replaced by a liquid-metal-jet. The metal-jet supports higher electron-beam power and can therefore generate higher X-ray flux.



Power loading capability

The X-ray power of all electron-impact X-ray generators is limited by the thermal power loading of the anode. In conventional solid anode technology, the surface temperature of the anode must be well below the melting point in order to avoid damage, and this is fundamentally limited by the anode target material properties, primarily the melting point and the thermal conductivity.

The liquid-metal anode is different since the limitation to maintain the target at well below melting point is removed. This is due to the fact that the material is already molten and that it is re-generative by nature. Fresh target material is supplied at a rate of close to 100 m/s. As the anode is continuously re-generated, the electron beam and anode interaction may actually be destructive.

Extreme brightness

Somewhat counter-intuitive, the power loading capability of small-focus X-ray tubes roughly scales with the diameter and not the area of the e-beam focus. Therefore, the brightness is inversely proportional to the source diameter.

By combining extreme power loading capability and a small electron focus, a liquid-jet source can achieve unprecedented brightness at micron spot sizes.

X-Ray spectra of liquid metal

In order to reach different X-ray emission lines, different metal alloys are used. First generation metal-jet sources feature metal alloys that are molten at more or less room temperature. Still, several alloys have emission characteristics similar to regular solid anodes. Future upgrades can also include alloys with higher melting points.

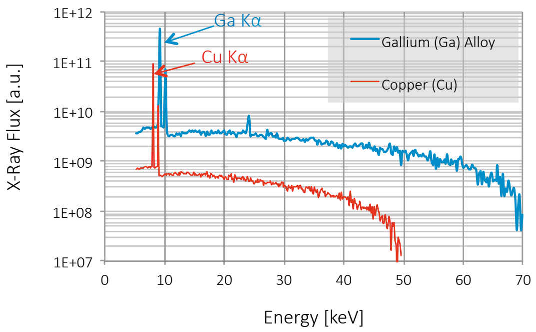
Gallium alloy

A gallium (Ga) rich alloy is available. Its 9.2 keV (1.3 Å) Kα emission line is close to the copper (Cu) Kα emission line.

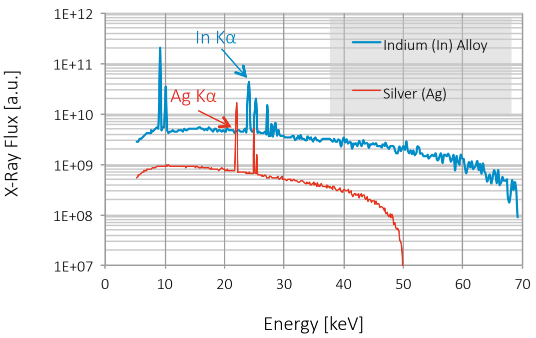
Indium alloy

An indium (In) rich alloy is also available. Its 24 keV (0.51 Å) Kα emission line is close to the silver (Ag) Kα emission line.

Spectra of gallium alloy and copper



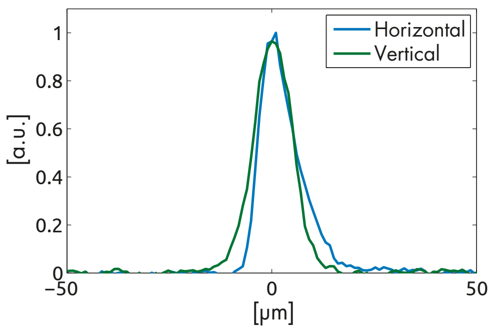
Spectra of indium alloy and silver



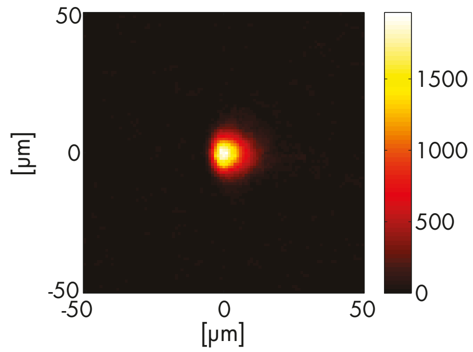
Spot quality

Thanks to advanced electromagnetic focusing and correctional optics together with a high brightness LaB_6 cathode, a high quality e-beam focus is achieved. Together with a continuously generated smooth liquid target surface, the source produces X-ray spots of very high quality.

Line profile through maximum



X-Ray spot



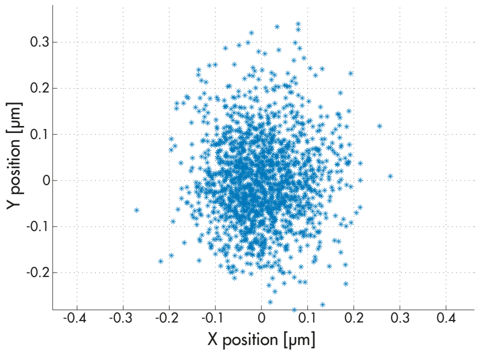
Tunable size

Both the spot size and the aspect ratio can be tuned freely.

Source stability

The spatial stability of the source is very high. The image below illustrates a spot centroid standard deviation of < 0.1 µm over 24 hours, as taken with pinhole camera mechanically coupled to the source.

Spot position over 24 h



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