doi:10.1017/S1431927620018577
Microsc. Microanal. 26 (Suppl 2), 2020
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High-resolution Imaging by Using Liquid MetalJet Microfocus and Nano-focus X-ray Sources

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Over the last years, the liquid-metal-jet technology has developed from prototypes into fully operational and stable X-ray tubes running in many labs over the world. Key applications include X-ray diffraction and scattering, but recently several publications. We will show very impressive computed tomography and X-ray microscopy results using the liquid-metal-jet anode technology, especially in phase contrast imaging and also show its applicability to industrial applications. Phase-contrast imaging achieves a significant improvement on the contrast and resolution of soft-issue with hard X-rays, however, the imaging quality, has been compromised by the low flux and brilliance using traditional microfocus tubes or adding optical elements. Therefore, the high brilliance liquid-metal-jet technology paves the way for the development of laboratory-scale phase-contrast imaging, especially its biomedical applications, by enabling shorter exposure time, higher imaging resolution and contrast. Besides, the high stability of the source at its top performance perfectly matches the requirement of the associated phase-contrast imaging techniques. Sharp characteristic line of Gallium, one of the main components in the liquid metal alloy, MetalJet fits well in the optics-based, i.e. X-ray zone plate, X-ray microscopy, while at the same time, reducing the exposure time and maintaining the ultimate resolution. Several application examples will be given during the conference, illustrating the capability of Metaljet in commercial or in-house built X-ray microscopy system. The Kα line of gallium, which is just above the absorption edge of copper, makes MetalJet beneficial for imaging copper with high contrast. Therefore, its advantage in electronic imaging, i.e., imaging copper in obsolete silicon materials. Besides the high brightness microfocus Metaljet tube, based on the advanced electron beam technology, a new nanofocus x-ray tube, with tungsten-coated diamond-transmission target, has been published and reached an extreme resolution of 150 nm line-spacing. Additionally, the unique features of the nanofocus tube also consists in the internal calibration of the current focal spot size before each scan and the high stability for long-time, comparative investigations. The extreme small, true round focal spot of the Nanotube can be used for non-destructive, sub-µm resolution 2-D and 3-D imaging investigation.

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https://doi.org/10.1017/S1431927620018577 Published online by Cambridge University Press