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P20 - Improving the lateral resolution in ion beam analysis by deconvolution of the point spread function of a nuclear microprobe

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The precise knowledge of the point spread function (PSF) of a nuclear microprobe should allow to improve the lateral resolution of maps created in ion beam analysis (IBA) using mathematical deconvolution. Therefore, a resolution standard for high current ion beam applications like e.g. particle induced X-ray emission or Rutherford backscattering spectrometry was developed, fabricated and characterized. The standard consists of two concentric structures made of thick titanium film on a glassy carbon substrate in order to ensure elemental and topographical contrast in the IBA method used for imaging with a sufficiently high yield to avoid unreasonably long measurement times. In addition, the deconvolution software 'PSFinder'was developed and optimized for the resolution standard. Both were used to determine the PSF of the ion nanoprobe LIPSION at the University of Leipzig. The dimensions of the PSF were cross-checked with measurements of Cu- and Ni-meshes, where good agreement was obtained. Furthermore, 'PSFinder'was used to increase the resolution of several element maps leading to a decrease of the edge full width at half maximum by up to 45 % after a deconvolution for structures of known dimensions. Moreover, different element maps with a low signal-to-noise ratio were deconvolved using a deconvolution algorithm based on the Wiener filter in order to investigate the limits of this approach. Here, the result was a clear improvement of the contrast and the resolution of the structures in the map. A quantification of the improvement, however, was difficult in these cases due to the low signal-to-noise ratio in the original images. Enabling the improvement of the resolution of elemental maps, the developed resolution standard and the associated deconvolution software 'PSFinder' are now integrated in the measurement protocol of the ion beam laboratory LIPSION.

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