Fast switching between 2D and direct, 3D XRF imaging using Collimating Channel Arrays and the Maia detector

Arthur R. Woll(1) and David N. Agyeman-Budu(2)

(1) Cornell High Energy Synchrotron Source, Cornell University, Ithaca, NY 14853 USA
(2) Department of Materials Science and Engineering, Cornell University, Ithaca, NY 14853 USA

arthurwoll@cornell.edu

Collimating channel arrays (CCAs), designed and fabricated at CHESS, are now in routine use as a collection optic to perform direct, 3D x-ray fluorescence (XRF) microscopy and spectroscopy at the micron-scale [1-4]. Specifically, employing CCAs enables confocal XRF with a critical dimension of approximately 2 microns at energies ranging from 2-30 keV. However, the complexity and sensitivity of a confocal setup – particularly at the micron scale – are sufficient to limit its use. For example, it is often desirable to locate a particular region of interest in 2D using traditional 2D XRF mapping, then switch to 3D mode for either the additional degree of resolution or for background reduction. Here, we present the first implementation of CCA-based confocal XRF in conjunction with the Maia detector, with a resolution along the incident beam of 20 microns. The CCAs consist of lithographically-etched channels in germanium, arranged such that they direct x-rays from the sample to a single row or column of pixels in the Maia detector array. A custom holder for the CCA is designed to mate to the beveled exit window of the Maia detector, and includes manual degrees of freedom to allow the CCA array to be aligned to the aperture in the Maia. After this initial manual alignment, the holder can be removed and replaced, allowing switching between 2D and 3D modes within 5-10 minutes. Detailed initial results will be presented, in addition to remaining challenges, prospects for improved performance, and potential applications.

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