Next-generation Microprobes: Detector Issues and Approaches

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X-ray microprobes are extremely important instruments for obtaining a full understanding of real-world samples, which typically display significant heterogeneity. Current instuments are limited in their capabilities by the available detector systems, whether they be spectroscopic detectors for analyzing fluorescence yield or x-ray imaging detectors for collecting microdiffraction data. The limitation of the spectroscopic detector is in its maximum count rate and readout time, and in spectral distortions accompanying the detection process. The imaging detectors are typically challenged by the required readout rate.

The proposed NSLS-II machine will provide around ten times the brightness of current 3rd generation machines, and so problems such as this will be even more acute. We are working to develop detector systems to address these issues. We are extending our existing multi-element silicon detectors [1] to provide full spectra and embedding the Dynamic Analysis [2] algorithm to perform spectral correction, deconvolution and element mapping on a photon-by-photon basis. We are also developing an imaging detector which implements an active matrix topology in high-resitivity silicon [3], thus avoiding the need for complex bonding operations between detector and readout. This construction also reduces development costs, since the readout electronics can be modular, and need not occupy the full detector area. This detector will be capable of reading out a 1000 x 1000 frame in 1ms.

References

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