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Requirements for Laboratory-Based EXAFS Spectroscopy with Cryogenic Detectors

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We explore the use of cryogenic detectors as the energy resolving component of a laboratory transmission EXAFS instrument. EXAFS (Extended X-ray Absorption Fine Structure) is a powerful X-ray technique that gives element specific information about the structure of molecules. It has the enormous advantage that it does not need a specialized sample form, such as a crystal, and so it can be generally applied to a wide range of fields such as catalysis, materials science, biochemistry, etc. It is currently only available at synchrotron radiation lightsources, where science tends to be restricted to high-profile experiments and by the limitations of working at a remote facility. The development of a laboratory EXAFS spectrometer capable of measuring transmission spectra would be a significant advance which should enable new science and novel applications. Such a laboratory EXAFS instrument could combine a high-resolution, energy-resolving, cryogenic X-ray detector with a broadband X ray generator to measure a transmission spectrum of a sample placed between the generator and detector. In this work, we examine the energy resolution, count-rate, and detector stability needed for good EXAFS spectra in such an instrument. We compare these to those of existing cryogenic technologies and show that the properties of Superconducting Tunnel Junction (STJ) detectors are well-suited for this application. A multi-pixel STJ array capable of operating in the typical EXAFS energy range of 3 – 12 keV would be a novel device, and we propose development paths based on STAR Cryoelectronics'existing commercial STJ platform.

Less than 5 years of experience since completion of Ph.D

N

Student (Ph.D., M.Sc. or B.Sc.)

N

Primary authors: Dr GEORGE, Simon J. (STAR Cryoelectronics); Dr CARPENTER, Matthew H. (STAR Cryoelectronics); Dr FRIEDRICH, Stephan (Lawrence Livermore National Laboratory); Dr CANTOR, Robin (STAR Cryoelectronics)

Presenter: Dr CANTOR, Robin (STAR Cryoelectronics)

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