Development of a miniature X-ray emission spectrometer (miniXES) for simultaneous multi-color emission studies of the non-resonant X-ray emission spectroscopy (XES), and sequential resonant XES for multiple edges/elements

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The miniXES style of x-ray emission spectrometer was designed to use flat crystals, in a pseudo-Johann or pseudo-von Hamos configuration, to get a spectrum in a single shot without having to scan an analyzer crystal [1]. In-situ calibration and readily swappable crystals to change energy range are hallmarks of the design, but the design targeted individual samples of small size, and user demand for higher efficiency and larger sample clearance has increased since inception. In particular, for these who are studying in-situ catalysis, high pressure and imaging, there is a need to upgrade to a system with improved clearance and improved collection efficiency.

In this talk, I will discuss ongoing developments in the design of the next generation of miniXES by using more crystals and larger pixel array area detector to improve the clearance and efficiency. In combination with the Advanced Photon Source Upgrade (APS_U), we expect to improve the efficiency ~500x after APS_U. Furthermore, I will discuss the methodology of using a miniXES-style spectrometer for simultaneous non-resonant XES for multiple emissions, and sequential resonant XES at multiple edges/elements. The experimental results of simultaneous non-resonant of XES of Fe Kβ and Cu Kβ, and sequential resonant XES of Fe Kβ and Cu Kβ under the same experimental conditions will be presented. These developments open up the revenue for time-resolved non-resonant XES at multiple edges/elements simultaneously, and in-situ/operando study of resonant XES at multiple edges/elements sequentially.

Reference-1: B. A. Mattern, G. T. Seidler, M. Haave, J. I. Pacold, R. A. Gordon, J. Planillo, J. Quintana, and B. Rusthoven, *Rev. Sci. Instrum*. 83 (2), 023901 (2012).