Micro X-ray Fluorescence: Instrumentation and Applications

George J. Havrilla, Kathryn McIntosh, Velma Lopez
Los Alamos National Lab, Los Alamos, NM

There are several different types of micro X-ray fluorescence (MXRF) available for elemental characterization of materials. The primary feature of all of these instruments is the spatially restricted spot size which provides elemental mapping capability of a wide variety of samples. There are several different commercial instruments all employing some type of X-ray optic using either single capillary or polycapillary features to spatially form and focus the X-ray excitation beam onto the sample. These provide xy elemental maps which can be used qualitatively to answer many analytical questions regarding the homogeneity or lack thereof of the specimen in question. Although not commercially available, confocal MXRF offers elemental information in 3D. The confocal volume formed by the overlap of the focal spots of the excitation beam and the focal spot of a polycapillary optic on the detector offers unique nondestructive 3D elemental mapping capabilities. Coupling the confocal MXRF with CT images of samples provides complementary 3D elemental information with the 3D structural and dimensional information. The use of doubly curved crystals (DCC) offers a novel approach to elemental analysis by significantly reducing the background and thereby increasing both the sensitivity and selectivity for elemental analysis. This concept is embodied in the hiRX instrument developed for actinide characterization of spent nuclear fuel. While this is a highly specialized application the hiRX can be adapted to many different analytes and applications. The empowering feature of all these instruments is that they are lab-based, providing powerful analytical capabilities for materials characterization and solving analytical problems. This presentation will survey these instruments and highlight the unique and complementary capabilities with examples of materials characterization and analytical problem solving. This work was supported by the Next Generation Safeguards Initiative, Office of Nuclear Safeguards and Security, National Nuclear Security Administration.