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Scientific capabilities of the Advanced Light Source for radioactive materials investigations

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The Advanced Light Source (ALS) of Lawrence Berkeley National Laboratory (LBNL) is a third-generation synchrotron radiation (SR) light source that began operations more than twenty years ago. The ALS is a U.S. Department of Energy (DOE) national user facility generating intense light for scientific and technological research. As one of the world's brightest sources of ultraviolet and soft X-ray beams and the world's first third-generation synchrotron light source in its energy range, the ALS makes previously impossible studies possible. Access to the resources of the ALS is through a competitive proposal mechanism within the general user program. Multiple ALS beamlines (BLs) are currently being employed for a range of radioactive materials investigations. These experiments are reviewed individually on a graded hazard approach implemented by the ALS in conjunction with the LBNL Environmental, Health, and Safety (EH&S) Radiation Protection Program that conform to DOE regulations. The ALS provides radiological work authorization (RWA), radiological control technician support, and general assistance for accepted user experimental programs for work with radioactive materials. There are three basic categories of experiments with radioactive materials at the ALS that serve to define the general safety measures that must be present to perform experiments.

There are no fully-dedicated BL facilities for studying radioactive materials at the ALS, that have been primarily actinides but have included technetium plus others. The SR techniques that are or have been utilized at ALS BLs with a diverse set of materials containing actinides include photoelectron spectroscopy (PES), angle-resolved PES (ARPES), near-edge X-ray absorption fine structure (NEXAFS), soft X-ray emission spectroscopy (XES), resonant inelastic X-ray scattering (RIXS), spectromicroscopy with scanning transmission X-ray microscopes (STXM), micro-diffraction, and of course, the suite of X-ray absorption spectroscopy (XAS) methods. Several ALS BLs are used on a regular basis for radioactive materials investigations with part of the core complement consisting of soft X-ray BLs 4.0.2-3, 7.0.1 (now temporarily unavailable) 5.3.1-2, 8.0.1, 10.0.1, and 11.0.2. Another group of useful BLs is composed of the higher energy BLs 9.3.1, 10.3.2, small molecule crystallography at BL 11.3.1, and superbend BLs located at 12.2.2. and 12.3.2.

Recent and past results highlights from the ALS with these aforementioned techniques and BLs will be briefly described to illustrate the capabilities of the ALS for the investigation of radioactive materials. As the ALS is recently undergoing a great deal of change resulting from BL upgrades and from recent DOE evaluations, particular attention will be given to the newest developments and to the long-range ALS scientific priorities. A full description of experimental capabilities, access, and safety policies of ALS BLs can be found on the ALS website (http://www-als.lbl.gov).

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