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Radioactive samples

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Synchrotron-radiation facilities are not populated with a large number of people with expertise in handling radioactive materials. This often leads to safety concerns that can delay or prevent experiments on radioactive materials from being conducted. Many of these concerns can be addressed in advance with well standardized research methods and procedures. This chapter discusses some of the methods and procedures that one can use to study radioactive samples at synchrotrons. It covers containment techniques and potential problems that can occur during measurements on radioactive samples.

1. Introduction

The study of radioactive materials at synchrotron-radiation facilities can often be challenging. There is added scrutiny to any experiment compared with those on nonradioactive samples. The majority of radioactive samples currently have to be measured within at least one level of containment, and often with as many as three levels, to minimize the risk of contamination of both the experimenters and the beamline equipment. These requirements, which are usually beyond those for more conventional materials, require the experimenter to significantly detail the experiment in advance. In addition, one usually has only one opportunity to perform the experiment correctly. Any abnormal conditions are often difficult to adjust at the synchrotron. For example, an adjustment that could trivially be performed on a nonradioactive sample or even in a laboratory that normally handles radioactive samples can be impossible. Remounting samples that have shifted during transportation can take a day and require the transfer of the sample to special laboratories near the synchrotron-radiation facility. These differences from working with nonradioactive materials require that the experimenter spends more time planning the experiments in advance. It is important to understand the conditions that will allow a successful measurement. In addition, one must evaluate the things that can lead to a failed measurement. It is also imperative to be ready to deal with a potential contamination scenario.

2. Advanced planning

The following information should be assembled before contacting the synchrotron about an experiment on radioactive samples. One should start by noting the technique or combination of techniques that will need to be used. For example, simple X-ray absorption fine-structure (XAFS) spectra can be measured with the sample in fluorescence or transmission geometry (Koningsberger & Prins, 1988). The sample geometry can be adjusted to highlight surface sensitivity over bulk measurement by using a grazing-incidence geometry (Heald, 1992; Den Auwer *et al.*, 2003). Will both

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