Handbook of Prompt Gamma Activation Analysis*

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Prompt Gamma-ray Activation Analysis (PGAA) is a unique, nondestructive nuclear analytical method with multi-element capabilities. It is most effective if intense neutron beams (especially cold beams) of nuclear reactors are used to induce the prompt gamma radiation.

Based largely on the authors' pioneering research in cold neutron PGAA, the handbook describes the methodology in a self-contained manner and reviews recent applications. The library of prompt gamma-ray data and spectra for all natural elements, also provided on a CD-ROM supplement, is a unique aid to the practitioner. The level appeals to a broad audience, which facilitates teaching and training.

This new, comprehensive handbook is written for teachers and university graduate students, applied nuclear chemists and physicists (radioanalytical chemists, neutron activation analysts, nuclear engineers, etc.), and researchers, as well as those who want to construct and operate a PGAA facility and those interested in non-destructive analytical methods and new applications for research reactors.

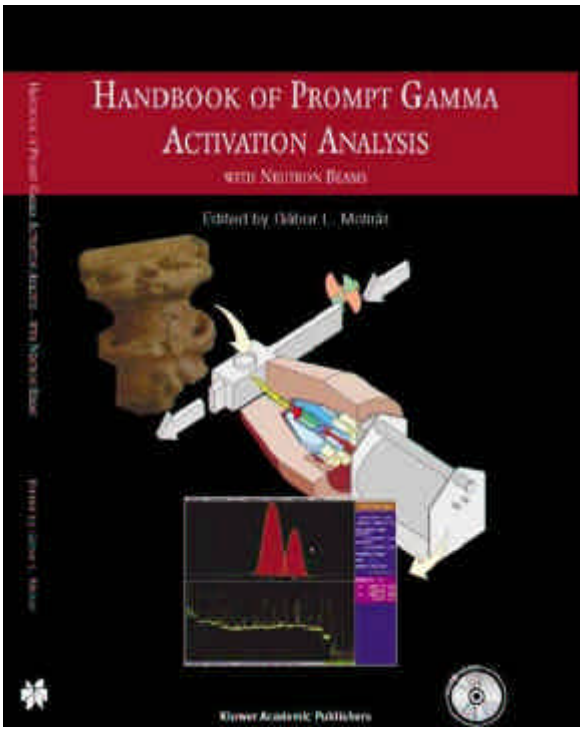

Figure 1. Handbook of Prompt Gamma Activation Analysis cover

The first chapter discusses the principles of the PGAA method. Here the fundamentals of PGAA are discussed, including the characteristics of neutrons, fundamental processes occurring during PGAA, probabilities of nuclear reactions, energetics of the capture process, and reaction rate equations. The characteristics of PGAA including analytical properties, characterization of prompt gamma spectra, and dynamic range and detection limits are also presented.

The second chapter addresses neutron beams and facilities. There are discussions of the basic parts of the PGAA system, neutron flux mapping and monitoring, shielding and background issues, and a description of existing PGAA facilities. Chapter 3 presents sample considerations and standard reference materials.

The fourth chapter describes gamma-ray spectroscopy with basic information on detectors, electronics, calibration procedures, Compton suppression, and spectrum evaluation. Chapter 5 discusses quantitative analysis including elemental identification, standardization, sources of error, and the utilization of short-lived decay gamma rays. The sixth chapter outlines the applications of PGAA in chemistry, industry, geology, archaeology, agriculture, environmental studies, biology, and medicine.

Chapter 7 contains the complete prompt gamma-ray spectrum catalog for all elements. The evaluation of the prompt gamma ray data is described and spectra and data for all elements are provided. A comprehensive appendix of reference data is provided for fundamental constants, properties of chemical elements, isotopic data, radioactive nuclides, x-ray energies and intensities, energy and intensity standards, thermal neutron capture data, resonance parameters and Westcott g-factors, and neutron capture cross sections.

The CD-ROM accompanying the book contains tables of gamma-ray cross sections in Microsoft Excel format and PGAA spectra in both Portable Document Format (PDF) and Canberra MCA spectrum format. In addition, a gamma-ray viewer application is provided to display and compare MCA and ASCII spectra. A demonstration version of Hypermet PC software for analyzing the spectra is also provided on CD-ROM.

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