X-Ray Fluorescence Spectrometry 2nd Ed

X-Ray Fluorescence Spectrometry

Second Edition

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X-Ray Fluorescence Spectrometry

CHEMICAL ANALYSIS

A SERIES OF MONOGRAPHS ON ANALYTICAL CHEMISTRY
AND ITS APPLICATIONS

Editor
J. D. WINEFORDNER

VOLUME 152

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PREFACE TO THE FIRST EDITION

It is now nearly 30 years since the publication, in 1959, of the Wiley/Interscience monograph *X-ray Spectrochemical Analysis* by Verne Birks. In the intervening years the X-ray fluorescence method has come through the birth pains of innovation, has survived the early frustrations of application, and has achieved the status of a reliable, fast, accurate and versatile analytical method. The analytical chemist of today has a vast array of different techniques available for the analysis and characterization of materials, and most would agree that among the more powerful and flexible of these methods are those based on the use of X-ray fluorescence spectrometry. The X-ray fluorescence method is a means of qualitatively and quantitatively determining elements by measurement of the wavelengths and intensities of characteristic emissions. The technique is applicable to all but the very low atomic number elements, with sensitivities down to the low part per million level. In the late 1950s the elements covered by the X-ray fluorescence method ranged from the higher atomic numbers down to titanium ($Z = 22$). By the mid 1960s the advent of first the ethylene diamine d-tartrate (EDDT) crystal and then the penta-erythritol (PE) crystal, along with the chromium and rhodium anode X-ray tubes, increased the coverable atomic number range to include all elements down to and including aluminum ($Z = 13$). Under certain circumstances even magnesium and sodium were measurable albeit with rather poor sensitivity. As we entered the mid 1980s the advent of layered synthetic microstructures (LSM's) has allowed measurements down to carbon ($Z = 6$) with fair sensitivity, and even boron at concentration levels of several percent. The sensitivity of the X-ray fluorescence method for the determination of small quantities of material has also improved significantly. A "small" sample in the late 1950s and early 1960s was typically of the order of milligrams. Today, use of synchrotron or proton source excitation, along with total reflectance geometry, allows measurements at the picogram level. For some, it is difficult to imagine development at the same exciting level over the next two decades. Many believe that X-ray fluorescence has come as far as it will. I personally do not subscribe to this view. I believe that the problems of rapid and efficient sample homogenization will soon be solved. The development of room temperature solid state detectors has much still to yield. Use of the synchrotron is beginning to reveal areas of

application of X-ray spectrometry hitherto not even considered. The use of the personal computer has yet to find its full exploitation in automating both quantitative and qualitative analysis. The development of combination X-ray diffractometer/spectrometers is at last beginning to show fruit. Present indications are that X-ray fluorescence spectrometry will continue to be an exciting and dynamic discipline.

PREFACE TO THE SECOND EDITION

I was gratified to learn that the first edition of this book found a place in the teaching of X-Ray Fluorescence Spectrometry. Both the American Chemical Society, and the International Centre for Diffraction Data, have, for a number of years, used the book as a course text in their X-ray fluorescence schools.

In preparing a second edition, I have taken the advantage in expanding the text to give more extensive coverage. In addition to a complete review and update of each chapter, new chapters have been added on "X-Ray Spectra" and "History and Development." The text is now about 30% larger than the first edition. I am grateful to those who have contributed to this work and am especially indebted to Dr. Sue Quick and Don Desrosiers for their painstaking work in proofing the manuscript.

Newtown Square, PA RON JENKINS

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