To be published in Transactions of
the American Nuclear Society

LBL-3865
Summary
Preprint
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RECENT DEVELOPMENTS IN X-RAY FLUORESCENCE ANALYSIS USING SEMICONDUCTOR DETECTORS

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September 1975

Prepared for the U. S. Energy Research and
Development Administration under Contract W-7405-ENG-48

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RECENT DEVELOPMENTS IN X-RAY FLUORESCENCE ANALYSIS USING SEMICONDUCTOR DETECTORS*

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SUMMARY

During the past several years the importance of X-ray fluorescence analysis using semiconductor detectors has increased substantially. The initial impetus for development in this field resulted from the improved energy resolution capabilities of modern semiconductor detector spectrometers. Subsequent refinements in low-noise pulse processing techniques have reduced the electronic noise figures below 100 eV for practical detector systems. Detection of characteristic X-rays as low as 185 eV has been shown to be possible with such systems.

The sensitivity for fluorescence analysis has been greatly improved following the realization of the importance of detector background and the understanding of methods to reduce it substantially. Detection limits below 1 ppm are now typically achieved in most systems.

The advantages of X-ray fluorescence analysis using semiconductor detectors have already been demonstrated in a number of diverse applications. Measurements of elemental contamination in air pollution samples, biological specimens, and medical applications have been reported by a number of groups. Cross checks of results using competitive analysis techniques have verified the inherent accuracy possible with the technique.

Much of the recent development work in the field of X-ray analysis with semiconductor detectors has been concerned with improved excitation sources. The use of charged particles in place of the more conventional photon excitation has been investigated by a number of workers. They have demonstrated the excellent sensitivity which can be achieved with charged

* This work was performed under the auspices of the Energy Research and Development Administration.

particles on certain classes of samples. A number of comparative studies of the two excitation methods have been performed and the relative advantages of each method are becoming better understood.

The use of polarized photon beams has also been investigated as a means of reducing background scattered by the sample. Although this could improve sensitivity in certain applications, the practicability of the method is limited by the lack of suitable intense sources.

Methods of pulsed excitation have been used with encouraging results and a complete analysis system based on a pulsed X-ray tube has been developed. The pulsed tube operates in a feedback loop with the semiconductor detector which causes the excitation to be shut off immediately upon detection of an event. This eliminates the possibility of pile-up during the analysis time and results in an increased output counting rate compared to continuous sources. The operation of such a system presents unique and interesting problems in the control of the experimental parameters necessary for analysis. The implications of these and other innovations on analytical systems will be discussed.

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