Chemical Analysis of Polycyclic Aromatic Compounds

Edited by

TUAN VO-DINH

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PREFACE

Polycyclic aromatic compounds (PACs) are ubiquitous environmental pollutants that represent the largest class of suspected chemical carcinogens. PACs have been a topic of great interest in a wide spectrum of research disciplines ranging from analytical chemistry to biology, toxicology, and epidemiology, as evidenced by the many monographs devoted to PACs in the last decade. In the last few years, important advances have been made in improving existing analytical methods and developing new techniques for analysis of PACs. Many of these new techniques have appeared in technical journals and symposium proceedings but have not been critically reviewed in a comprehensive monograph. The need for such a monograph is critical because much instrumentation and many analytical technologies have emerged since the early 1980s.

Probably one of the most formidable challenges in chemical analysis of PACs is the characterization of complex mixtures. PACs generally occur in "real-life" samples as complex mixtures that vary greatly in concentration of individual components. The sensitivity and specificity required of analytical techniques are critical factors for environmental assessments and human health studies because compound structure can drastically affect the biological activity of PACs.

In the quest for elucidation of PAC carcinogenicity there is a continuing evolution from investigations of the parent homocyclic systems, the polycyclic aromatic hydrocarbons (PAHs), to investigations of heterocyclic PAC systems. It is noteworthy that many PAHs undergo photochemical reactions in the atmosphere, leading to the production of heterocyclic PACs. Because PAHs cannot account for all the biological activities of many samples, this evolution has led to increased recognition of the important role of heteroatoms upon PAC genotoxicity. It is, therefore, a purpose of this monograph to deal with the broader class of PACs, which include both homocyclic and heterocyclic species.

Recently, analytical methods and instrumentation have experienced dramatic development and growth. New developments in experimental procedures and stationary phases for gas chromatography, high-performance liquid chromatography, and supercritical fluid chromatography have led to

improved analysis of PACs. Luminescence spectroscopy, with its inherent sensitivity for aromatic systems, has greatly benefited from the advances in laser and detector technologies. Multicomponent analysis of PAC mixtures can be performed more effectively using phase-resolved detection. Simple and rapid techniques such as synchronous luminescence and room-temperature phosphorescence provide cost-effective screening of complex samples, whereas site-selection or line-narrowing techniques offer selective means for chemical analysis. These advances have also been complemented by new developments in micelle-mediated separation and analysis methods. New developments in mass spectroscopy and in Fourier transform and resonance-enhanced multiphoton ionization mass spectrometry have further improved the structural characterization of complex mixtures. Infrared and Fourier transform infrared spectroscopies have complemented Raman spectroscopy in both qualitative and quantitative analysis of PACs. Innovative techniques such as UV-resonance Raman and surface-enhanced Raman spectroscopies have made significant advances in improving the sensitivity of detection. A new generation of analytical techniques based on photoionization spectroscopy, photothermal spectroscopy, and immunoadsorbent techniques has also been developed and applied to PAC analysis.

Early detection, understanding, and, ultimately, prevention of PAC-related carcinogenesis are among the most important challenges facing this and future generations. The development of effective methods and instrumentation for chemical analysis should provide a critical contribution toward achieving these important goals and toward ensuring the development of ecologically viable and safe technologies. It also provides the necessary tools to support the establishment of effective strategies and rational policies to protect ecosystems as well as the health and well-being of people.

It is our hope that the information contained in this monograph will foster the critical and creative thinking needed to develop the full potential of analytical techniques for the important class of PACs and will contribute to fundamental basic knowledge while ensuring harmonious relationships among mankind, the environment, and technology.

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TUAN VO-DINH

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