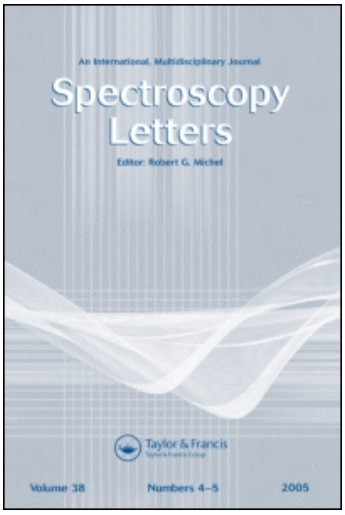

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Application of Spectroscopic Methods to Environmental Problems

Spectroscopic techniques have long been useful in basic studies of physical chemistry and chemical physics. With the advent of computers, developments in instrumentation, and the awareness of environmental protection, such methods have acquired a much wider usage in the instrumental chemical analysis of environmental samples such as soil, sediment, suspended particulate matter, and wastewater. Wet chemical techniques have now been superceded in most analytical laboratories, and sample treatment prior to instrumental analysis has been kept to a minimum. The major reason why different laboratories obtain different results from environmental analyses is not due to the use of different instrumental techniques but to the failure to follow the same sampling and pretreatment protocols.

To many researchers without the prerequisite background, the spectrometer is now a black box that gives a result, say, just like a digital voltmeter. This is a dangerous scenario, and it is essential that the user is aware not only of the basic theory and advantages but also the limitations of the particular technique in question. Certainly, the advantages of spectroscopic analytical techniques often include sensitivity, safety, noninvasiveness and/or remote access, miniaturization, inexpensive running costs, and rapid, automated sample turnover. Major breakthroughs in analysis have come from hyphenated techniques comprising component separation interfaced with spectroscopic detection. Even formerly esoteric spectroscopic techniques, such as Mössbauer, electron spin resonance, x-ray photoelectron, and atomic emission, have now become common tools in environmental analysis, with specific advantages for speciation analyses.

The purpose of this special issue of *Spectroscopy Letters* is to illustrate the range of applications of spectroscopic techniques to some different environmental compartments: air, water, sediments, particulate matter, and wastes. The energy of probing radiation in the papers spans from the radiofrequency to synchrotron radiation. Concerning the high-energy techniques,

x-ray microanalysis is shown to be a rapid screening tool for metals in sediments. Energy dispersive x-ray analysis is capable of single-particle analysis, and the advent of easier access to synchrotron radiation enables sub-microgram per gram analyses of metals in biological tissues. In the ultraviolet region, frequency-quadrupled Nd-YAG radiation has been employed with photoacoustic detection in order to quantify ambient ozone levels down to a few parts per billion. A technique using surface plasmon resonance has been employed to determine the toxic secondary metabolite aflatoxin B_1. The more established technique of transmission Fourier transform infrared spectroscopy is well illustrated herein. It has been employed as a method to identify the stage of decomposition of organic matter in wastes and to monitor ambient concentrations of chlorinated hydrocarbons. Some limitations of quantifying organic carbon by using the C-H stretching vibration bands in diffuse reflectance infrared spectra are pointed out. At the low-energy range of electromagnetic radiation, the capability of nuclear magnetic resonance and interfaced techniques is clearly presented in the identification of the constituents of complex matrices. Finally, it is satisfying to observe the power of integrated spectroscopic approaches in characterizing humic substances and soil organic matter. Spectra from surface-enhanced Raman, diffuse reflectance infrared, nuclear magnetic resonance, and ultraviolet-visible techniques are employed together with conventional mass-spectrometric and carbon-nitrogen-hydrogen analyses in the two examples illustrated herein.

It's a great pleasure to communicate with these authors. The papers show a huge commitment to the solution of environmental problems. Let's hope that environmental policymakers can also play their important role in creating a favorable environment for future generations.

Peter A. Tanner, Associate Editor