Photoacoustic and Photothermal Science and Engineering

Andreas Mandelis, MEMBER SPIE
University of Toronto
Photothermal and Optoelectronic
Diagnostics Laboratories
Department of Mechanical and
Industrial Engineering
5 King's College Road
Toronto, Ontario M5S 3G8 Canada

Kirk H. Michaelian
Natural Resources Canada
CANMET Western Research Centre
P. O. Bag 1280 Devon, Alberta
T0C 1E0 Canada

The field of photothermal science and engineering has reached a level of maturity and diversity such that it is quite difficult for an individual researcher to be aware of all new and important developments, even in his or her particular domain of application. Fortunately, there exist specific publications, mostly journals, which carry the majority of research articles in a given subfield; this is true for the spectrum of activities ranging from basic physics and chemistry to novel instruments and measurement methodologies. Nevertheless, keeping up to date with progress in this field is a difficult task if it must be done through random journal publications, precisely due to its extraordinary diversity.

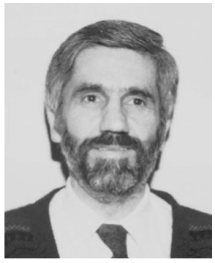
A sign of the coming of age of the field is the evolution of the continuum from the basic sciences through to engineering techniques and technologies used in the industrial sector. This continuum has not been captured before in a single publication within the variety of specialized texts now available in the literature. The present special section of *Optical Engineering* seeks to convey to the interested reader exactly the feeling of diversity and of this continuum from the fundamental to the applied and the industrial. Of major value are the references cited at the end of each paper in the special section, as they are a means to further one's exploration into the field. In general, the papers referred to are readily accessible to the photoacoustic and photothermal community.

As coeditors, we are well aware that it is just as important to communicate to workers in the broader optics/applied optics community the rich potential of our science and engineering, in terms of its very cross-disciplinary character and applications across diverse areas. For this reason we chose *Optical Engineering* as the vehicle for the presentation of the state of the art and science of the photoacoustic/photothermal continuum. Trends in recent years are unmistakably in the direction of applications, instrumentation, devices, and measurement techniques. It is our belief that further breakthroughs can and will be made when due attention is paid to potential areas of application hitherto nominally irrelevant to photoacoustic or photothermal treatment. And it is our hope that some of these breakthroughs may possibly appear from cross-disciplinary work coming from inside the more conventional optics community, once our colleagues become more familiar with our field.

For these reasons the 27 papers that follow in this special section have been divided into six disciplinary subfields ordered from the fundamental to the applied: (1) spectroscopy, analytical chemistry, and photochemistry; (2) thermophysics; (3) thermal-wave nondestructive evaluation (NDE) and laser ultrasonics; (4) semiconductor characterization; (5) instruments and sensors; and (6) experimental and analytical methodologies.

We wish to thank our referees for the generous dedication of their valuable time to safeguard the quality and integrity of this special section. We would also like to thank all of the authors for their fine contributions, and Brian Thompson for giving us the opportunity to expose the readership of *Optical Engineering* to this most cross-disciplinary branch of applications of optical science and engineering.

Andreas Mandelis is a full professor in the Departments of Mechanical-Industrial and Electrical Engineering, University of Toronto. He received his BS degree in physics from Yale University in 1974, and MA, MSE, and PhD degrees from the Applied Physics and Materials Laboratory, Department of Mechanical and Aerospace Engineering, Princeton University. He worked in the electronics industry in the Silicon Process R&D as a member of scientific staff, Bell-Northern Research Labs, Ottawa, in 1980 to 1981. He is the director of the Photothermal and Optoelectronic Diagnostics Laboratories (PODL) at the University of Toronto. He is the author and coauthor of more than 135 scientific papers in refereed journals, and the coauthor of the book *Physics, Chemistry and Technology of Solid-State Gas Sensor Devices* published by Academic Press. He is the Editor-in-Chief of the book series *Progress in Photothermal and Photoacoustic Science and Technology*, Volume III (*Life and Earth Sciences*) recently published by the SPIE. He has also been a guest editor of a number of special issues in the area of photothermal/photoacoustic phenomena. He is an Associate Editor of the *Review of Scientific Instruments*. He is on the editorial or advisory boards of the *Journal of Applied Physics, Applied Physics Letters, International Journal of Thermophysics, The International Journal of NDT&E*, and *Analytical Sciences*. He has two patents in the area of photothermal-wave imaging and instrumentation and he is a Fellow of the American Physical Society and a Member of the ASME K7 Committee on Thermophysics. His scientific interests span the photothermal instrumentation and measurement science field mainly focused on the research and development of novel laser-based inspection and monitoring systems, sensor devices, analytical and spectroscopic methodologies, and nondestructive evaluation and subsurface imaging.



Kirk H. Michaelian is a senior research scientist at the CANMET Western Research Centre, Natural Resources Canada, in Devon, Alberta. He received his PhD in chemical physics from Simon Fraser University in 1976. After postdoctoral positions at the universities of Toronto and Alberta, he joined CANMET in 1981. He is the author or coauthor of more than 75 papers in refereed journals, one book chapter, and an editor of two volumes of conference proceedings. He is a member of the Chemical Institute of Canada, the Canadian Association of Physicists, and the Spectroscopy Society of Canada. His research interests include photoacoustic infrared spectroscopy, Raman spectroscopy, the application of these techniques to the characterization of hydrocarbons, clays, and clay complexes, and numerical analysis of Fourier transform and dispersive spectra.