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EDITORIAL

Emerging concepts and strategies in analytical glow discharges

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It is amazing to see how an established and revered spectrochemical source like the glow discharge (GD) has been able to adapt to the rapid technological advances and changing requirements of society; and not simply to survive, but to thrive. The GD analytical community remains dynamic and vibrant, and it has been augmented in these last years by investigators interested in new and exciting GD sources, such as atmospheric-pressure GDs, miniaturized sources, and GD plasmas for molecular analysis. Indeed, the future of the GD looks bright.

Progress in the materials sciences continually poses new challenges for analytical chemistry. The technical demands placed upon coated materials and thin films continue to increase, with thinner and more complex films being developed to meet market needs. In turn, these trends place growing demands upon analytical techniques to keep pace. Without doubt, GD spectrometry is a first-line method used to perform elemental quantitative depth-profile analysis of materials, with accurate results obtained within a few minutes. This attribute has kept the GD at the forefront of elemental analysis for years. Commercial instruments consisting of direct-current or radio-frequency GDs are routinely operated, either in continuous or pulsed mode, coupled with advanced optical-emission spectrometers and a variety of mass spectrometers. Recently, specific GD techniques have emerged that have unique performance in the analysis of technical coatings and multi-component thin films; some of these are detailed in this special issue.

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Applications of analytical GDs now encompass a much broader scope than simply the elemental analysis of solid materials, however. Specialized GD structures have been developed to operate at atmospheric pressure and under ambient atmosphere, providing elemental information directly from liquids and gases. Miniaturized GD systems of increasing sophistication are being developed, with the objective of providing analytical performance in a much smaller, portable, and efficient instrumentation package. Moreover, the range of chemical information provided by the GD source is also increasing. The GD has demonstrated the ability to provide molecular chemical information by both optical and mass spectroscopy. Furthermore, it has been shown that a single GD source can provide these different types of chemical information from a single sample. For example, a GD source for mass spectrometry can be used to determine the elemental composition of a sample, indicating the number and type of atoms that compose the sample, and then switched to another mode of operation to provide a molecular-mass spectrum, elucidating the molecular form and structural bonding of those atoms. The utility of this unique analytical capability is just beginning to be investigated. It is also worth noting that GD plasmas are being adopted for applications beyond conventional analytical use, in so-called plasma-medicine applications, materials-surface treatments, electron-spectroscopy applications, and as an integral part of chemical sensors. These contributions confirm that GD research is focused not only on improving the performance of current elemental-solids analysis methods for organic and inorganic films a few nanometers thick, but also on developing new methods to face new analytical challenges.

This special issue contains a compendium of varied analytical studies centered on the GD source, including new instrumental developments, fundamental characterizations, and innovative applications. This small catalog of research articles will introduce the readership to the new capabilities of the GD source, with the hope that they may be encouraged to exploit these attributes in their own research.

Our special thanks go to the authors for the contributions. We wish them all the best in their professional life. We are also very thankful to the reviewers for the thorough and on-time reviews of the papers and, of course, to the Editorial team of Analytical and Bioanalytical Chemistry for the invitation to act as guest Editors of this issue and for all their support.

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