Glow Discharge Plasmas in Analytical Spectroscopy
Dedicated to our family, friends and colleagues
for their support through the years . . .

RKM
JACB
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Almost by definition, analytical spectroscopy is a science of problem solving. In this ever-changing world (both politically and technologically), the problems presented to the analytical chemist seem to be changing at an even greater pace. New problems generally require the development of new strategies and tools to solve. Of the modern approaches to spectrochemical analysis, the use of glow discharge (GD) devices seems to be showing some of the greatest breadth in terms of the ways that the devices are being used to solve problems. The opening lines of the Preface of a book edited by one of the present editors (R.K.M.) almost a decade ago stated that ‘One of the greatest challenges remaining in the area of analytical atomic spectrometry is the development of more universal methods for the direct analysis of solid materials’. This statement remains true to this day, but the breadth of the diversity of potential applications has evolved far beyond the realm of solids elemental analysis to molecular analysis of solids, elemental analysis of gases and liquids and indeed molecular species analysis of gases and liquids.

The potential use of glow discharge sources in such diverse areas of application is really a product of the basic physics by which the devices operate. By their nature, GD sources provide means of converting solid specimens into gas-phase atoms and molecules in a controlled fashion. This quality is, of course, the basis of the still-growing use of glow discharge sources in bulk solids and depth-resolved elemental analysis. Gas-phase atoms and molecules are subsequently exposed to a plasma environment that is mild in comparison with spectrochemical sources operating at atmospheric pressure [e.g. flames, inductively coupled plasmas (ICPs) and microwave-induced plasmas (MIPs)]. Mild in this case refers to the fact that the kinetic temperatures are just above room temperature as opposed to thousands of degrees celsius. As such, gaseous molecules are not de facto broken down to their atomic constituents. In addition, the inert gas environment minimizes greatly the possibility of complicating side-reactions. Collisions taking place in the plasma are very effective, though, in exciting and ionizing gaseous atoms and molecules. In this way, atomic (optical) emission and atomic and molecular mass spectrometries can be employed to detect sputtered analytes.
Recent developments have now brought new sample introduction schemes to bear. Methods for analyzing liquid microsamples and flowing streams as well as a wide variety of gas-phase environments have been developed. While the types of GD instruments that are commercially available have been fairly static over the last decade, developments in these new application areas are surely going to yield very exciting new tools of high practical utility for problem solving in materials, environmental and biological chemistry.

Glow Discharge Plasmas in Analytical Spectroscopy is a multi-authored volume that hopes to capture the present state of the art of analytical applications while also highlighting the exciting new developments that will permit problem solving over an ever-expanding range of application. The chapters in the volume have been arranged first to present the basic technology and science underlying the most widely employed implementations of GD sources, then to highlight specific application areas of technological (and economic) significance. The final few chapters serve as a window to new applications of glow discharge devices in areas that are both nontraditional and also of high potential impact. As such, it is intended that the volume will be of use both to current practitioners and to those in the future. The authors of the chapters are clearly recognized world leaders in their respective fields, and in fact the entirety of analytical spectroscopy. They are leaders in both hardware development as well as application areas. Each author has been intentional in discussing their respective topic in relation to alternative methodologies, and as such the reader should gain a better understanding of the context of the work. It is intended that the content should be suitable for the technician, staff scientist and laboratory manager alike.

The Editors would like to express their appreciation to each of the authors for their thoughtful and valuable contributions. The writing of a chapter in such a volume is not a glamorous or invigorating undertaking, it is truly a service to the community as a whole. For this we are very grateful. We would also like to acknowledge the editorial staff of John Wiley & Sons who have shepherded this project from conception through to production. They have provided both a pleasurable and professional environment in which to work.

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