Book Review

Laser-induced Plasmas and Applications. Edited by Leon J. Radziemski and David A. Cremers. Pp. xiv + 445. Marcel Dekker. 1989. Price $99.75 (USA and Canada); $119.50 (rest of world).

This book describes the fundamental physical aspects of laser-produced plasmas and applications ranging from chemical analysis to laser-driven nuclear fusion. The first two chapters are devoted to the fundamental physics of the laser plasma, with the material divided between those processes which lead up to plasma formation and those which follow. The first chapter discusses the role of processes such as inverse-Bremsstrahlung and multiphoton ionisation, without an assumption that the reader is familiar with the details of such topics. Some useful compilations of fundamental parameters are given, and many relationships are described which would be useful to anyone involved in research in this area. The second chapter is devoted to post-breakdown phenomenon and describes the propagation of the laser-induced plasma into the atmosphere and the thermal coupling between the laser and the target. Although spectrochemical applications are not directly discussed in this chapter, the material is very relevant to such applications as it determines how sample material will interact with a laser-induced plasma and what variables control the relevant processes. Laser plasma diagnostic techniques are discussed in the third chapter. The underlying physical principles of these measurement techniques are emphasised rather than instrumentation. This chapter is primarily concerned with the regime of laser irradiances applicable to laser fusion research, and the X-ray diagnostic methods used to probe such plasmas. A section on optical probe methods, which are more relevant to laser plasmas found in analytical chemistry applications, is included, and discusses Thompson scattering, Faraday rotation and interferometric methods. Chapter 4 deals with the principles and applications of laser sustained plasmas. These are cw (continuous wave) plasmas which can operate at atmospheric pressure in air or in rare gases; as such they have some obvious applications to spectrochemistry. The next two chapters cover topics which will probably be only of passing interest to analytical spectroscopists, inertially confined fusion and laser-based semiconductor fabrication. Spectrochemical applications are the topics of the next three chapters. The applications are divided between those in which the laser plasma is used for both vaporisation and excitation (Chapter 7) and those in which laser vaporisation is used only as a means of sample introduction to a separate method (Chapter 9). A good summary of the general results of studies conducted over the past two decades regarding laser ablation for spectrochemical analysis is given. Chapter 8 is meant to deal with fundamental physical aspects of using a laser-produced plasma for chemical analysis of solids, but largely avoids the critical issue of whether the elemental composition of the ablated materials matches that of the sample. The book ends with a chapter devoted to new applications. The topics discussed in this chapter are related more to the regime of plasmas found in laser fusion experiments, such as laser generated X-rays and high-energy particles.

Having no direct experience in the area of laser-induced plasma, I found the book to be very informative and useful. The diversity of applied fields covered in the book can be a bit confusing, but not overly so. This can be an effective means of catching up on developments in different but somewhat related fields. I would recommend the book to anyone involved, or contemplating involvement, in research in the area of spectrochemical application of laser plasmas.

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