BOOK REVIEWS

Film Deposition by Plasma Techniques

By Mitsuharu Konuma, Springer-Verlag, 1992, 221 pp.

This monograph reviews the fundamentals and applications of low-pressure, electric gas discharge plasmas for the deposition of thin solid films and for surface modification. Applications of this technology are focused primarily on the electronic, optical and related materials processing fields. It is organized with several chapters at the beginning reviewing some of the basic principles of low-pressure, nonequilibrium discharge plasmas. The later chapters cover various technological applications.

Chapter 1 presents a few of the basic plasma phenomena including Debye lengths, electron plasma frequency, and various sorts of gaseous plasmas as characterized by plasma density and electron temperature. Chapter 2 summarizes some fundamentals of collisional processes including electron-neutral and ion-neutral cross sections, potential energy diagrams, and electron and ion transport characteristics in low-pressure gases. The treatment is not deep, but covers most of the basic principles including some data.

Chapter 3 describes some discharge phenomena. There is a brief survey of direct current (dc), radiofrequency (rf), and microwave discharges. There is no attempt to be quantitative, and there is no discussion or even mention of the growing literature on discharge modeling and simulation. I found this to be an unfortunate omission, since a great deal of progress has been made in this area in the last five years and has helped tremendously in putting the field on a more quantitative basis.

Chapter 4 reviews discharge diagnostics. This material is covered more completely than the section on discharge phenomena. This may be due to the fact that most of the described techniques were fairly well known by about the mid-1980s. Optical techniques mentioned include laser-induced fluorescence, laser absorption, optical emission, coherent anti-Stokes Raman, and optogalvanic spectroscopies. Langmuir probes, electron spin resonance and microwave interferometry round out the chapter. Unfortunately, the author chose not to include any film characterization techniques in the review of diagnostics. This is perhaps the single biggest omission in the book. Indeed, the author mentions the importance of film characterization techniques in his preface. One can often obtain unique film properties from plasma-deposited films. The use of appropriate film characterization methods is essential in any plasma deposition or surface modification program.

Surface processes are reviewed in Chapter 5, including adsorption, reaction, and sputtering. This chapter leads into the applications chapters, starting with physical vapor deposition. Sputtering, reactive sputtering, ion plating techniques, and some discussion of the reactor types used in each application are presented. Chapter 7 consists of a survey of films deposited, gas chemistries used, and reactor configurations employed in plasma-enhanced chemical vapor deposition (PECVD). Finally, Chapter 8 concludes the book with various surface modification technologies using plasmas such as nitriding and carbiding metals, and anodization of semiconductors.

In summary, the treatment of all material is at an elementary level with a rather cursory coverage in most cases. The restriction to deposition eliminates the etching literature, which is much broader and deeper than the deposition literature, and contains many insights into plasma processing that is also relevant to deposition technologies. Major drawbacks are a lack of any mention of the recent progress on discharge modeling and any discussion of film characterization techniques. In spite of these limitations, I find this to be a useful addition to the existing literature, which is far from extensive. There are a few collections of chapters from various authors available that cover some of the same material, but these collections typically suffer from a variable level of quality and depth of coverage. Considering the current state of the literature, this book is a useful contribution to the field of nonequilibrium plasma materials processing.

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Chaotic and Fractal Dynamics—An Introduction for Applied Scientists and Engineers

By Francis C. Moon, John Wiley & Sons, New York, 508 pp., $59.95.

This book is an extension of the author's popular book *Chaotic Vibrations* by the same publisher in 1987. The added materials include more recent experiments on chaos, including J. Ottino's experiments on chaotic mixing, a more in-depth introduction to the concept of fractals and a new chapter on the fashionable topic of spatio-temporal chaos and automata simulations. The content and style of the book, however, remain similar to the earlier book, and most of the comments below apply to both books.

It is a valuable reference on chaotic dynamics from the physical (experimentalists') perspective. A large fraction of all experiments on chaos are carefully categorized and explained in the most rudimentary mathematical language. Simple numerical experiments and curioshop toys that can pique the curiosity of an intelligent science and engineering major are also detailed. As such, it offers a bridge between the highly mathematical treatises on nonlinear dynamics, such as the classic by Guckenheimer and Holmes, and the popular science paperbacks that recently appeared on the *New York Times'* best-seller list. It belongs on the shelf of every researcher in the field and is an especially informative primer for a graduate student or someone interested in entering the field. It is unsuitable as a text, however, because of