Book Review

Combustion Fundamentals, by Roger A. Strehlow
McGraw-Hill Book Company, New York, 1984, 554 pp., $41.95.

In 1968, Roger Strehlow's book entitled *Fundamentals of Combustion* was published. It was intended as an introductory text in combustion for the advanced undergraduate or beginning graduate student in engineering. The present volume, an updated version of the 1968 book, has exactly the same objective. In addition to being more current, the new book unquestionably is better than its predecessor as a teaching tool in many respects.

The present volume has sixteen chapters, in comparison with the ten of its predecessor. However, the length has increased by fewer than 100 pages, so the book is manageable in size and reasonably priced for students. The larger number of chapters is mainly a consequence of reordering of material for pedagogic reasons, as well as addition of new material for updating. A considerable amount of material will be found, packed palatably into an economical number of pages.

The first five chapters introduce basics of kinetic theory, thermodynamics, chemical kinetics, and reactive gasdynamics, as did the first five of the 1968 volume. However, there are significant differences, as will be indicated below. The next four chapters, presenting basic combustion topics, deal with adiabatic and vessel explosions, plug-flow reactors, shock-tube kinetic measurements, stirred reactors, and detailed mechanisms and simplified modeling of combustion reactions (all in one chapter), diffusion flames, premixed flames, and detonations. These chapters have extracted and updated the most basic material from Chapters 6-9 of the 1968 book, so that the first nine chapters of the present volume constitute a good basic course. The remaining seven chapters present material that is more advanced or more recent, such as flame holding, turbulent combustion, ignition and extinction, detonation initiation and failure, flame instabilities, rocket combustion, and air pollution. Much of this later material has been taken from the more advanced parts of the last four chapters of the 1968 book, but a great deal of it is entirely new.

The changes made in the first five chapters illustrate the improvements that may be found in the present volume. The original introductory chapter on atomic and molecular structure has been deleted—quite reasonably so because students now generally know this material before taking the course, and as in-depth treatment of the subject cannot be given in a reasonable space at the level of the course. Instead, there is a new chapter presenting stoichiometry and thermochemistry at an elementary level—a very important chapter because students so often do not properly understand these essential fundamentals. The thermodynamics of open systems has been deleted; equations of chemical equilibria now are developed in a more elementary manner by considering a system of fixed mass. In the conservation equations there is now an indication of transport effects, in contrast to the restriction to inviscid flow present in the first version. In general, the first book has relatively little information on combustion processes in which transport processes are significant as in diffusion flames, but the present volume is much more balanced in including much recent material on this subject.

It is likely that many readers will be surprised to find how much new material is contained in this book. For example, an elementary representation of activation-energy asymptotics is given in the extended section on laminar-flame theory. Of course, specific criticisms of a book like this always can be raised. Only two will be mentioned here—one from the beginning, on thermodynamics, and the other from the end, on soot production in flames. Internal energy is defined as an extensive property and is indicated to be a function of two intensive properties, pressure and temperature, which implicitly requires an (unstated) specification of the mass of the system (p. 3). The controversial ion mechanism, involving $CH + O \rightarrow CHO^+ + e^-$, is cited as important in soot formation, but the well-established alternative of a nonionic pyrolysis-polymerization route is not discussed (p. 478). Specific criticisms like this are unimportant, because any consequent misunderstandings are readily avoided through guidance of a good instructor. This new volume is an excellent source for a wide range of material in combustion.

Deserving of special mention in connection with teaching is the greater number of problems at the end of each chapter, in comparison with the earlier text. I understand that the author is preparing a solution manual for the problems that will be available to instructors upon request. This will further facilitate use of the volume as a textbook, its primary objective.

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