

*Kenneth K. Kuo*

## **PRINCIPLES OF COMBUSTION**

Wiley-Interscience Publications, John Wiley and Sons,  
New York, Chichester, Brisbane, Toronto, Singapore  
1986. 810 pages, £ 52.70

Considering the complex character of the problem, very few reviews have been published on combustion. The works published so far have generally dealt either with the theory of combustion, or only with its practical approximation, or only with certain of its aspects. Nobody has previously attempted to summarize and give a constructive picture of the theory, practice and reported results on combustion. The first such attempt has now been by Kenneth Kuan-yun Kuo in his work "Principles of Combustion".

This is not surprising, as Prof. Kuo has dedicated his whole life to the investigation of combustion science. He has published over 60 papers on the combustion field and has been the principal investigator of many large research contracts. Dr. Kuo has assisted in the development of 400 major laboratories, a high-pressure-combustion laboratory and a CO<sub>2</sub> laser laboratory. These labs are among the best-equipped ones for combustion and propulsion studies in the U.S.A.

The book has 10 chapters.

### Chapter 1 Review of chemical thermodynamics

The most important relations of chemical thermodynamics are summarized in this Chapter: the first and second laws of thermodynamics, the equilibrium and nonequilibrium of thermodynamics in 103 pages.

### Chapter 2 Review of chemical kinetics

This Chapter deals with the essential kinetic fundamentals of combustion in 48 pages.

### Chapter 3

Among others, attention is paid to the diffusion laws, the problems of conservation of momentum and energy, and the equations for multicomponent systems, in 70 pages.

### Chapter 4 Detonation and deflagration waves of premixed gases

The problem indicated in the title is discussed in 54 pages.

### Chapter 5 Premixed laminar flames

In this Chapter the author deals with the problems of laminar flames, the effects of chemical and physical variables on flame speed, and the methods of measuring flame velocity, in 54 pages.

**Chapter 6 Gaseous diffusion flames and combustion of a single liquid fuel droplet**  
In 55 pages, this Chapter treats the theory of lamina diffusion flames, the burning of a single fuel droplet, and that of liquid droplets.

**Chapter 7 Turbulent flames**

111 pages are dedicated to turbulent flames. This Chapter deals, among others, with the fundamentals of turbulent flow, turbulence models, and turbulent reacting flows with nonpremixed reactants and with premixed reactants.

**Chapter 8 Combustion in two-phase flow systems**

This discusses the regularities of spray combustion, demonstrating spray-combustion system, fuel atomization, spray statistics, and models developed for spray combustion processes.

**Chapter 9 Chemically reacting boundary-layer flows**

This Chapter treats the following subjects in 115 pages: Applications of reacting boundary-layer flows, governing equations for two-dimensional reacting boundary-layer flows, boundary reactions, chemical kinetics of laminar and turbulent boundary-layer flows with different types of reaction.

**Chapter 10 Ignition**

In 56 pages, this Chapter, covers ignition stimuli and devices, spontaneous ignition, ignition of solid propellants, ignition of liquid-fuel sprays in a flowing air stream, ignition of boron particles, ignition and flame spreading over a solid fuel in a hot oxidizing gas stream.

Since continuity can not be guaranteed between the chapters, which relate to gigantic scientific fields, each with its own known and accepted designation method, the author correctly gives the necessary additional symbols at the beginning of the chapters. The references at the end of the chapters are also appropriate and useful. The "Homework" to be found at the end of the chapters directs the attention of the reader to the most important questions of the chapter, make him think further and summarize. It follows, that the book is excellently suitable for students and gives a theoretical basis for experts to solve numerous problems, summarizing the basic knowledge in detail and logically.

It should be stated, however, that the emphasis of this book is on the theoretical modelling of combustion, and only few references are to be found to the experimental techniques. The development still desires the practical application of the theoretical relationships or references to them, which can be found in the book, although an increase of their number would further add to the value of the book.

The author covers an enormous field, and he systematizes it very extensively and methodically. He accounts for his statements with clear argumentation and he makes every effort to omit unnecessary information. The contents of the book correspond to its title "Principles of combustion". The text is well edited, and the Figures are clearly arranged. It is unfortunate that cal values are given in the book, instead of joule values, which would correspond to the SI system.

T. Kozma