

Supramanian Srinivasan: Fuel Cells—From Fundamentals to Applications

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In 1983, a report on recent advances on fuel cells and their applications published in “Chemical & Engineering News” was entitled “Fuel Cells: The Procrastinators Power Source.” Some 24 years later, the situation has not changed dramatically. Fuel cells for some special applications—like methanol-based fuel cells for laptops, hydrogen-supplied fuel cells for emergency backup, or natural-gas supplied ones for residential heating with combined use of heat and electricity—are appearing in slowly growing numbers, but the great breakthrough has still not yet materialized. This is certainly not caused by a lack of effort in electrochemical and materials science labs—it seems to be related more to fundamental problems of hydrogen storage (in case of hydrogen/oxygen fuel cells) and of suitable catalysts for direct methanol air fuel cells as well as to economic considerations. Nevertheless, significant advances both in fundamental and applied research have been achieved in the past decades justifying the publication of a book covering all aspects of this still attractive—albeit old—subject.

The present book has been written by an expert recognized by everybody in the special field of fuel cells as well as in electrochemistry in general. Most unfortunately Srin—this way the author appreciated being addressed by fellow electrochemists—passed away before writing the final chapter. Several scientists pooled resources to finish his book—and from the reviewers’ point of view, it is a most appropriate tribute to an outstanding teacher and scientist.

The large area of the subject is treated in four large parts each subdivided into several chapters. Some of them—

especially the first part—may be considered unnecessary because the content seems to be treated well and sufficiently in other electrochemistry textbooks. But in this book—and particularly in this first part—the selection of subjects considered by the authors as being related specifically to fuel cells appears very appropriate and concentrated. Thus somebody (especially when not being an electrochemist himself) will read this first part with considerable gain when making himself familiar with terms and methods particularly related to fuel cells. Certainly some topics related to, e.g. sensors or secondary batteries or to the evolution of electrochemistry, are only distantly related to the book’s title—but even these brief pieces will most likely be read with considerable gain. The introduction to both fundamental and experimental methods of electrochemistry as well as the condensed overview of applied electrochemistry are valuable sources of information even for somebody not in the fuel cell business at all.

The second part covers really all aspects of fuel cells. Starting with a brief history (already going back to Grove’s work in 1839), the first chapter in this part provides an overview. The following chapters deal with electrocatalysis (in a rather condensed, but nevertheless appropriate length taking into account the number of reviews already available) and experimental methods as applied in fuel cell research and development.

The step (actually it seems more like a long and winding road) from half-cell experiments to real-world systems is covered in the third part. Particular attention is paid to porous electrodes as the central component and to modeling and simulation of cells and complete systems. Fuel production, storage, and transportation (as already indicated above) will most likely remain major challenges in further development. One chapter in part three is devoted to all conceivable aspects of these subjects.

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Somewhat overlapping with the third part, the final fourth part covers applications of fuel cells and assessments of technological and economical aspects—some prognosis is added at the end. In the starting chapter, the state of the art is reviewed with attention being paid to all those components and details already treated in preceding chapters. The list of real-world applications is long and impressive—and might correct somewhat the somber introductory remark above. Upon closer inspection, it becomes evident that most applications are very specific and far away from mass markets. This feeling is somewhat supported (and corrected only in a few cases) by an overview of competing technologies challenging the advance of fuel cell application. Accordingly, the final prognosis is reluctant at best.

All chapters end with suggestions for further reading, a list of cited references, and some problems. The novice in the field will appreciate these opportunities to evaluate his just-acquired knowledge. He would also like to benefit from a complete list of the numerous acronyms—they are mentioned in the index only incompletely. This is a real omission in a textbook.

The book has been carefully prepared and produced. There are only minor printing errors (e.g., in the table of contents, there are two sections covering the recent history of fuel cells from 1958 to present and from 1965 to present, somehow a “Century 196” appears on p. XV, and the name Ragoné correctly spelled in the index suffers a change into Ragonne on p. 153). Somewhat less funny and frequently rather annoying is the quality of many figures. Certainly an author having created numerous figures for many publications may be tempted to utilize these resources. It may even be considered necessary to acknowledge permission to reprint these own figures when they have been published previously elsewhere. It is certainly not acceptable to see these figures reproduced in sometimes almost illegible gray tones, in extremely poor resolution, or in styles and formats changing from figure to figure. In a textbook, which is very helpful otherwise this sets a poor example for any student. This is the only (and not a major) weakness of an otherwise very valuable book. Its price is adequate and puts it within reach of both libraries and researchers. It can be recommended wholeheartedly.