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## **Lithium batteries: science and technology, Gholam-Abbas Nazri and Gianfranco Pistoia (eds)**

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Among the various successful developments in electrochemical energy technology the advent of nickel-metal hydride batteries might be somewhat larger in number of sold cells, but in sheer market volume and in public reputation, there is hardly any match for lithium batteries. This has not always been the case: early lithium batteries operating with liquid cathode materials like thionylchloride were certainly successful in some very specific and not extremely popular applications, their image was unfortunately marred by initial safety problems, the absence of safe rechargeability procedures and the fairly high price. Nevertheless, many patients with pacemakers and users of scientific instruments are still glad to have these batteries. The rather unobtrusive use of these batteries is no match to the success of safely and efficiently rechargeable lithium ion batteries—and their success is so impressive that both editors and contributors of this book flatly forget any lithium-containing battery (whether of primary or secondary type) besides this type. Certainly no big fault when considering the market and the major roads of scientific progress, but in a scientific publication this omission should not have occurred. Another fault is in the introduction, wherein an overview of the various aspects treated in the following sections, part and chapters is provided. Unfortunately, the editors presumably write this overview well in advance of the final editing—the arrangement of parts and number of chapters differ definitely from the actual text. This is certainly a minor problem, the editor's expertise both as actual researcher in the area and as consultant provide a solid foundation. In a few cases, the reader even finds evidence of communication between the authors—something rather unusual in this

kind of endeavor. The result is nevertheless effective—it spares the reader to read repetitions.

Contrary to most other collections of review papers, published by an editor as a book on a given topic lacking reasonable structuring and interconnectivity between the various parts, this book has a very logical and evident structure providing easy access for anybody interested in this area of research and technology. The 23 chapters are written by authors well known in the field for their original contributions. In the first part fundamentals of secondary lithium ion batteries are treated. In particular materials and chemistry aspects of cathode materials are introduced. Electronic properties relevant to the operation of intercalation compounds again predominantly as cathode materials (including an introduction to concepts of theoretical chemistry applied to these materials) and the synthesis of selected cathode materials are discussed. This contribution looks at first glance slightly misplaced in the fundamentals section; but it provides an illuminating introduction beyond general consideration; it even treats economical considerations in large-scale manufacturing of selected materials. Anode materials are given short shrift in this part. Fortunately, the following part covers anode materials exhaustively on 199 pages. Every conceivable aspect including size effects down to nanoparticles, nitrides and silicides, metallic alloys and even the state of metallic lithium as anode material in secondary batteries is treated. Nevertheless, all relevant aspects of carbon—still the most popular anode material—are covered. About the same space is provided for cathode materials. Starting with a general overview popular and already established materials as well as rather new systems are covered. Sometimes the authors seemed to get lost in details, which is interesting only for an expert in the particular type of material. The introductory overview easily compensates this potential problem. Experimental aspects pertaining to methods for

research in this area especially suitable for the study of phase transitions (e.g. transmission electron microscopy) are included. Somewhat less space is occupied by the chapters on electrolytes, i.e. electrolyte solutions, solvents and supporting electrolyte salts. In the introductory overview, some general aspects of electrolyte solutions are treated, this chapter seems to be somewhat unessential. Certainly, oxygen is not reduced at very positive electrode potentials, and neither is reduction of OH a well-known process in this range of potentials as claimed in this chapter. Nevertheless, all relevant aspects of liquid electrolyte (solutions), polymeric electrolytes and inorganic solid electrolytes (both glasses and ceramics) are treated. Tables prepared without any ordering principle, like those presented on page 533, are somewhat hard to use, an alphabetic order of the solvent might have been helpful. The growing importance of polymeric materials in lithium ion batteries is matched in the chapter on polymeric electrolytes, accordingly glasses and other "hard" materials are given brief coverage only.

Certainly appropriate, but nevertheless somewhat unexpectedly in a book aimed mostly at the scientist in

this area battery systems and their applications in electric vehicles, medical systems and consumer use are treated in a fashion, helpful to the researcher not too familiar with aspects of electrical engineering. In this part primary lithium batteries are included—something very appropriate when thinking of the widespread use for medical applications.

Beyond the faults already mentioned, the book is carefully prepared. Only a few pictures are somewhat below standard, but still legible. The subject index is limited to two pages only—something certainly unusual for a book of this size and scope and taking into account the very broad intended readership. The rather minor weaknesses should keep nobody intending to enter the field of lithium batteries or attempting to update his library without subscribing to any particular (and mostly rather expensive) journal to purchase this book for an institutional library. For the personal bookcase, the price might be somewhat too high—a phenomenon unfortunately not entirely unknown in scientific publishing.