Molten Salts Chemistry and Technology

Molten salts play a major role in numerous technologies. The most notable one is aluminum-making, in which aluminum is extracted from a molten fluoride bath by electrolysis. Similarly important is the electrolytic winning of alkali metals and magnesium from their chlorides. Other applications of molten salts are in the quenching and tempering of steels, the surface treatment of alloys, and the re-processing of spent oxide nuclear fuel. They are also used as an electrolyte in the molten carbonate fuel cell, and as a heat storage medium in solar energy concentrators. Slags also fall into the category of molten salts, and their role in processes such as steel-making is well established. A more recent addition to the field is ionic liquids. These salts, which contain at least one organic ion and are liquid at ambient temperature, are now of increasing interest for industrial applications.

There is a stark contrast between the importance of molten salts in industrial processes and their absence from the teaching curricula and research programs of most universities. That is also reflected in the lack of textbooks on the subject. As a step towards filling that gap, Molten Salts Chemistry and Technology, edited by Marcelle Gaune-Escard and Geir Martin Haarberg, is a new compilation of articles covering several key areas of the subject. The book is divided into 7 chapters, and contains 60 individual articles, all written by leading experts. The book is very well presented; its structure is coherent despite the large number of authors, the language standard is satisfactory in every chapter, and the many figures, equations, and tables are of high quality. The book is also an abundant source of references to the primary literature.

The first chapter of the book is concerned with aluminum electrolysis. The articles cover the main topics adequately, but could have been arranged in a more logical order. A case in point is the last article by Lorentsen, which would have made a good opening, before then turning to more specific aspects, such as electrolyte properties, electrode processes, alternative electrode materials, and cell geometries. The second chapter describes new processes for application in electrowinning. These include the calciothermic reduction of oxides, the synthesis of NF_3, and the preparation of nickel nanoparticles. While all of these certainly deserve a mention, it is surprising that the well-known FFC process is not covered.

Chapter 3 focuses on modeling and thermodynamics. Here, experimental results from different salt systems are compared with theoretical considerations with regard to structure, complex formation, solubility, and conductivity. Chapter 4 is devoted to high-temperature experimental and analytical techniques. The emphasis is on the use of NMR spectroscopy, aimed at identifying the structures of species in salt melts, and on various electrochemical methods, used for elucidating electrode processes and deposition. Altogether, these articles provide a good representative overview.

Chapter 5 is concerned with ionic liquids. Most of these articles describe the deposition of metals that cannot be obtained from aqueous systems. An example of the application of ionic liquids in organic synthesis is described, and another highly readable article reports on the use of an ionic liquid for the in situ analysis of a biological system. The individual papers are of high quality, but the chapter is too short to adequately cover the huge diversity of current research on ionic liquids.

Chapter 6 is devoted to the application of molten salts in the nuclear energy industry, an important area that deserved a more extended treatment. Lastly, Chapter 7 deals with the roles of molten salts in other already established or still emerging energy processes and devices, including batteries. These two chapters in particular underscore the true relevance of molten salts for the further development of sustainable energy technologies.

Like all collections of articles, the book also has a number of weaknesses. One major shortcoming is the absence of a genuine introductory chapter to discuss the fundamental physicochemical properties of molten salts, as well as their availability, preparation, toxicity, and price. Another drawback is that some of the articles do not fit into the chosen chapter structure. An example is the paper by Fray, which is included in the chapter on aluminum, but in fact discusses the role of carbon in molten salt systems in a far wider sense. There are also some regrettable omissions, such as the absence of the molten carbonate fuel cell and of alloy surface treatment, even though both are mentioned in the cover blurb, and that of slag-based processes.

Overall, the book is of great value to everybody working in the field of molten salts, both in academia and in industry, and it should be available in every library there. However, it should be pointed out that the book's main target group is the high-temperature molten salts research community, whereas low-temperature systems are given less attention.

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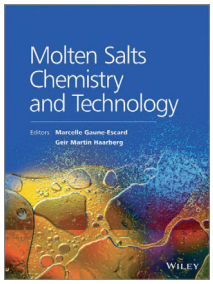

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