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Physical chemistry of melts in metallurgy

BOOK REVIEW

F.D. Richardson. Academic Press, London, 1974, two volumes.

This work is intended as an outline of 'present knowledge covering the chemistry of melts in metallurgy', including liquid metals, slags, molten salts and their interactions with gases and with one another. The broadness of the subject requires a selection of topics, and the systems discussed are primarily those which either exemplify important principles or are of industrial importance, but almost exclusively in ferrous metallurgy. The work is organized into sections dealing with structure and kinetic properties, thermodynamic properties, and chemical and electrode kinetics. In these sections the author summarizes the basic physical chemical principles in relation to their application to liquid metals, salt melts, polymeric melts (primarily silicates) and slags and mattes. The wide rnage of topics treated, together with the generally clear description of theory and its application to metallurgical systems makes these volumes a valuable source of information. The treatment is unfortunately marred, however, by serious omissions relating to recent developments. Although the references appear to be up to date in some of the chapters, e.g. those dealing with liquid metals and the final chapter on reactions between liquid metals and slags or salts, the literature surveys in the chapters dealing with ionic melts are seriously out of date. The author states in the Preface: 'In many cases our knowledge of high temperature systems is greater than our understanding', and propose to illustrate patterns of behaviour 'even when theory is lacking and the data cannot be linked satisfactorily together'. Nevertheless many recent developments that shed considerable light on observed patterns of behaviour are excluded. For example, there is no mention of conformal ionic solution theory, its application to the calculation of multicomponent phase diagrams, or its rationalization of the variation of thermodynamic properties of salt mixtures with ionic size and charge. There is nor reference to recent molecular dynamics computer experiments which contradict the hole-jump concepts of structure and diffusion in molten salts. While a detailed exposition of these topics may be considered outside the scope of metallurgical physical chemistry, their existence should be pointed out to students of the subject. In the section on polymeric melts virtually no reference is given to work on those systems most analogous to the silicates, the fluoroberyllates. The latest reviews on ionic melts cited in this work are of 1967 vintage, with no reference to more recent reviews edited by Petrucci (1971), by Mamantov (1969), and by Braunstein, Mamantov and Smith (1971, 1973), or to the Russian reviews by e.g., Delimarskii. Much recent work on electroslag remelting is also neglected. While many of the omissions may result from the inevitable delays between initiation and completion and publication of this comprehensive yet brief work, its value to students of metallurgical physical chemistry would have been greatly enhanced by inclusion of a bibliography of work closer to the frontiers of the field.

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