Condensed Matter Physics, 2000, Vol. 3, No. 2(22), pp. 457–458

A new modern book on electrolyte solutions

(J.Barthel, H.Krienke, W.Kunz. Physical Chemistry of Electrolyte Solutions: Modern Aspects. Steinkopff, Darmstadt and Springer, New York, 1998, 401 p.)

Received April 21, 2000

A new book entitled "Physical Chemistry of Electrolyte Solutions: Modern Aspects" was recently published in the series "Topics in Physical Chemistry" edited by Deutsche Bunsen-Gesellschaft fur Physikalische Chemie. The authors of this book are very well known specialists from Institut fur Physikalische und Theoretische Chemie of Regensburg University in Germany. Among them there are the founder of this Institute Prof. Dr. Dr. hc. Josef Barthel, Prof. Dr. Hartmut Krienke and the present director of the Institute Prof. Dr. Werner Kunz.

For the last decades much research has been devoted to the study of different physical phenomena in Electrolyte Solutions. The progress in this study has been specifically stimulated by new theoretical and experimental techniques traditionally belonging to different areas of physics and chemistry. As it is noted in the preface the purpose of the reviewed book is a survey of the state of the art of electrolyte solutions. The authors have managed to cope with the task.

In the book there are six chapters. The first three of them present a good introduction concerning the general background of electrolyte solutions. First chapter introduces the basic features of electrolyte solutions. A classification of solvents and electrolytes is given together with a description of the molecular architecture of electrolyte solutions in terms of ionic association and solvation. The second chapter presents the phenomenological approach to transport and relaxation phenomena in electrolyte solutions. The properties of electrolyte solutions and their solvents obtained from high frequency permittivity and ultrasonic measurements are also given. The third chapter shows how the properties of electrolyte solutions can be represented with the help of chemical models which use the association concept. It is demonstrated that such a concept can be very efficient for understanding and prediction of a large variety of properties.

The following three chapters offer different aspects of the statistical mechanical theory of electrolyte solutions. The fourth chapter introduces the statistical mechanical background of the electrolyte solution theory based on the calculation of spatial correlation functions. This consideration is given in the ionic approach (McMillan

Mayer level) in which the solvent is considered as a continuum and most attention is focused on the behaviour of the solute ions. The application of the pair correlation function concept is discussed in structural investigations of electrolyte solutions using modern diffraction methods. The ion-molecular approach (Born-Oppenheimer level) in the electrolyte solution theory is discussed in the fifth chapter. At this approach in addition to the solute, the solvent molecules are explicitely considered as discrete particles. The authors focus their attention on the explanation of the McMillan-Mayer level parameters from Born-Oppenheimer level calculations. The sixth chapter on the advanced modern statistical-mechanical concepts permitting the description of the transport process beyond the approaches given in the preceding chapters rounds off the modern electrolyte theory. The guiding thread of the discussion of this chapter is the assignment of the dynamic process to the timescales beginning with very fast particle motions and proceeding via the mesoscopic to the macroscopic or hydrodynamic level. For this purpose the authors discuss the information obtained by molecular dynamic simulation, by Brownian dynamics simulations, by Smoluchowski level description and finally by continuity equation approach initiated by Debye, Onsager, Fuoss and developed for the modern level by the Rostock group of Falkenhahen, Ebeling, Kremp, Krienke and coworkers which introduced the concept of the direct correlation force and developed the non-equilibrium integral equation approach.

In the appendix the authors present a practical information needed for the description of electrolyte solutions. Among them we find physical properties and empirical parameters of water and organic solvents, limiting ion conductivities of electrolyte solutions, solvent and solution permittivities of electrolyte solutions, Pitzer parameters for the osmotic pressure of nonaqueous electrolyte solutions, symbols and abbreviations used in the book. Unfortunately authors did not give the chemical formulae for the solvents in table 7.1, which could be useful for the reader.

As a suggestion for the next edition we could advise to present in the book the modern development of the associative concept in the electrolyte theory connected with the application of associative integral equation approach developed for the last decade. Unfortunately the book contains some misprints. For example the expression for $(y_{\pm}^{\mathrm{HS}})^2/y_{\mathrm{ip}}^{\mathrm{HS}}$ in equation (6.83 d) corresponding to the contact values of the pair distribution function for hard spheres is not correct. As for me the authors from the former Soviet Union are not enough cited.

Nevertheless, the reviewed book presents an excellent encyclopaedic view on the state of the art of electrolyte solutions. As it is noted in the preface, the book is addressed to chemical engineers looking for an introduction to this field of increasing interest for various technologies as well as scientists working in various fields and wishing to have an access to a broad field of modern electrolyte chemistry. The book is written in good language with a successful combination of experimental and theoretical materials and has no analogues in literature.

M.F.Holovko