

## Preface

A series of materials called superionic conductors, which exhibit high ionic conductivity, have been attracting attention in terms of their engineering application as solid electrolytes. In promoting such an application, the importance of basic research based on, for example, physics and chemistry, has been recognized, and has led to the establishment of an academic field called solid-state ionics in which science and engineering have been integrated. Superionic conductors are highly promising functional materials. As a stepping stone in the development of new superionic conductors that can be utilized as functional materials, efforts to reevaluate solid-interior diffusion and conduction phenomena of ions and molecules in a superionic conductor on the basis of basic physical properties, and to clarify mechanisms governing these phenomena from a microscopic standpoint are important. How are diffusing ions associated with material structures within a superionic conductor? What types of interaction are diffusing ions undergoing with the host ions surrounding them? How important is the correlation among diffusing ions in their motion? At present, we understand only some part of the structures and dynamic characteristics of superionic conductors, and accordingly, intensive research on these basic physical properties will be required in order to utilize superionic conductors as functional materials.

To date, the research on superionic conductors has focused on studies of engineering applications in which the transfer phenomenon and motion of ions within a solid are utilized. In addition, basic research seems to focus only on the behavior of ions. We consider that, in the future, such a superionic conduction phenomenon should be considered to be based on the dynamics of the ions composing a solid, and should be clarified on the basis of various types of information including electronic states. Among the basic physical properties of superionic conductors, electrical conductivity is a significant physical property. However, in addition to electrical conductivity, various material properties of superionic conductors, including magnetism, optical properties, structure, and thermal properties, should be reevaluated, and applied to roles envisioned by humans, which can become functionalities based on the behavior of ions in a solid. Through such processes, a new aspect of superionic conductors as functional materials should be sought in the future. Furthermore, without dwelling on materials that are conventionally classified as superionic conductors, members of the Discussion Meeting on Superionic Conductor Physics intend to pursue and search for possible new functionalities based on the behavior of ions in a solid.

The first Discussion Meeting on Superionic Conductor Physics was held in December 1987; since then, the meetings have been held every 3 or 4 years, with issues of interest being

actively discussed. In April 2000, the 4<sup>th</sup> meeting entitled “Discussion Meeting on Ion Transport Properties of Ionic-Conductive Solid,” was held in Okayama. The theme of this 4<sup>th</sup> meeting was that to further advance the research from the basic standpoint of physical properties, it would be necessary to provide a forum and sufficient time for the presentation of basic studies in this field. There was also the need to foster young researchers and to vitalize research. In May 2001, the 5<sup>th</sup> Discussion Meeting was held in Kyoto. The Ion Transport Society of Japan was inaugurated at this meeting. The concept behind the 5<sup>th</sup> meeting was the same as the previous concept; however, having established our society, albeit small, for the first time, we hoped to advance more active research activities with the impetus of this organization as a stepping stone. Thereafter, the 6<sup>th</sup> meeting was held in Kyoto in May 2002, the 7<sup>th</sup> meeting in Kumamoto in May 2003, and the 8<sup>th</sup> meeting in Ibaraki in May 2004.

To advance the research on the physical properties of ionic conductors from a more global viewpoint, we invited foreign researchers to participate in our Discussion Meeting and held the first International Research Meeting on Superionic Conductor Physics on September 10-14, 2003. It was held in Kyoto, where The Ion transport Society of Japan was first inaugurated. Thirty-eight domestic researchers (including five guest speakers), and eight foreign guest speakers from Austria, Denmark, Germany, India, New Zealand, Poland and United States, participated in the meeting. Lectures, questions and answer sessions and free discussions were actively carried out. The research topics ranged widely, including theory, modeling, simulation, crystalline structure, nuclear magnetic resonance, electric conduction, optical properties, and thermal measurement. To publicize the outcome of this international meeting to related researchers, we decided to publish these proceedings of the meeting. Almost all the participants submitted their papers, which were carefully reviewed and processed. The successful publication of these proceedings is due to the efforts of the organizers of the international meeting, whom we deeply thank.

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