別紙様式８

研 究 主 論 文 抄 録

論文題目　構造不規則物質におけるイオン伝導機構と緩和現象
(Ion Transport Mechanisms and Relaxation Phenomena in Structurally Disordered Materials)

熊本大学大学院自然科学研究科　理学専攻　物理科学　講座
(主任指導　安仁屋　勝　教授)

論文提出者　ドゥーグ　ジャーン　レオポルト
(Ndeugueu Jean Léopold)

主論文要旨

The first part of this work deals with the behavior of the a.c. conductivity in various superionic glasses. Here, we propose a relationship that links the first sharp diffraction peak wave number and the fitting parameters of the a.c. conductivity power law (Jonscher law). We check the workability of this relationship and find that it describes accurately the experimental data. After a deep discussion, we conclude that the universal aspect of the a.c. conductivity power law reflects the universal pattern of the potential barrier at intermediate length scales. This finding enables us to clarify the role of the dimensionality in the transport mechanism of lithium-ion in disordered lanthanum lithium titanate perovskites. The second part of the study is concerned with the problem of ion relaxation phenomena in glass-forming materials.

Firstly, we carry out a comparative study on two well known models that describe the temperature dependence of viscosity in these materials, that is the Random Walk (RW) model and the Bond-Strength-Coordination Number Fluctuation (BSCNF) model. We find that both models show excellent agreement with experiments. However, the BSCNF model is preferable insofar as it provides a single equation with clear physical meaning that describes the behavior of both the "fragile" and "strong" systems.

Secondly, we investigate the behavior of the α-relaxation time at crossover temperature in various glass-forming materials. We find that it depends not only on the type of the materials, but also on their compositions. Strengthened by previous works, we conclude that the so-called universal "magic" relaxation time at crossover

temperature does not exist. We also investigate in detail the fragility index dependence of the β-relaxation time at glass transition temperature. The striking similarity between this behavior and that of the α-relaxation time at crossover temperature allows us to reinforce the idea that there is a correlation between α and β-relaxations in glass-forming materials.

Finally, based on the BSCNF model, we shed the light on the role of plasticizers in transport mechanism of lithium-ion in conducting polymers. Accordingly, we propose a relationship between the normalized temperature range of cooperativity and the fragility index. The results obtained indicate that by contrasting a neat poly(ethylene oxide)-based lithium-ion conductor with different plasticizers, the ionic conductivity increases dramatically whereas the mechanism of lithium-ion transport remains unchanged. There are compelling experimental evidences in the literature that confirm this result, however, to date, no theory has been elaborated to address the issue.