Structural and Dynamical Study of Na-P-S Superionic Conducting Glasses by X-Ray Diffraction and γ-Ray Quasi-Elastic Scattering Experiments

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Recent years, demand for batteries with higher quality is increasing because of the rapidly spread electric vehicles and mobile devices. All-solid-state batteries especially attract much attention as next generation batteries because they are much safer than Li-ion batteries currently used. Superionic conducting glass Na_2S-P_2S_5, which is composed of PS_4 tetrahedrons and Na^+ ions, is amorphous and has high electrical conductivity. This glass is one of the candidate for the electrolytes in all-solid-state batteries, hence elucidating its structure and mechanism of the ion conduction has an important from the viewpoint of the material development. Up to now, microscopic ion conducting mechanism of Li_2S-P_2S_5 and Na_2S-P_2S have been studied based on its glass structure [1,2]. However, these studies are mainly based on static information, and dynamics of all ions in the system has not been measured yet. On the other hand, recently we developed γ-ray quasi-elastic scattering spectroscopy by using time-domain interferometry (TDI), which allows for measurement of the dynamics in the time scale from nano-second to micro-second in atomic and molecular spatial scales [3]. Here, we present our resent structural and dynamical studies on the Na_2S-P_2S_5 glass by the X-ray diffraction measurement, reverse Monte Carlo modeling and γ-ray quasi-elastic scattering measurement. We discuss the usefulness of the microscopic structural and dynamical information for clarifying microscopic ion conduction mechanism in the Na_2S-P_2S_5 glass.

References

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