High durable anion-conducting ionomer binder formed by on-site crosslinking
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The recent development of various anion-exchangeable polymeric membranes aims at being applied for solid alkaline fuel cells [1-3]. Solid alkaline fuel cells (SAFCs) are operated in the same principle of alkaline fuel cells, but use solid type electrolytes. Alkaline fuel cells typically use a potassium hydroxide or sodium hydroxide solution as electrolyte. On the other hand, polymers having functional groups to exchange anions such as quaternary ammonium group are able to be used as solid type electrolyte for solid alkaline fuel cells. SAFCs have advantages that are easier to handle systems at low operating temperatures (roughly room temperature~70°C), to have higher reaction kinetics at the electrodes than proton exchange membrane fuel cells (PEMFCs) and to use non-noble metal catalysts.

In this study, polyvinyl alcohol (PVA) was selected as the backbone material of ionomer binder because PVA is highly resistant to against acid, alkali and organic reagents as well as the production cost of PVA is relatively low. Moreover, it has a number of unique properties such as excellent film forming, non-toxic, odorless, high tensile strength, flexibility. Poly(vinyl alcohol) was quaternized to have anion-conducting ability using glycidiyltrimethylammonium chloride(GTMAC). To use anion conductive ionomer that is insoluble in water as electrode binder, they should be crosslinked. Furthermore, the crosslinking is able to provide mechanical stability. The quaternized polymers were investigated in terms of ionic conductivity, ion exchange capacity (IEC), FT-IR, etc. For long-term use of the ionomer solutions, it is necessary to confirm a long-term storage test of the ionomer solution stored at pH 3 at which the quaternized PVA can be crosslinked. It was stored in a refrigerator under 4 °C for 1000 hours to test stability of the ionomer binder solution. As a result, no change in IEC and water content was shown, and ionic conductivity increased initially and then slightly decreased. It might be concluded that cold storage of the ionomer binder solution resulted in high durable properties in that the main polymer properties were not changed so much.

References