

## Studies in ionic conductivities and phase behaviors of tetraalkylammonium hydroxide clathrate hydrates for solid electrolytes

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Ionic clathrate hydrates are generated by an ionic interaction between an ionic guest and a surrounding host water framework, which quite differs from non-ionic clathrate hydrates stabilized by van der Waals interaction. Most pure ionic clathrate hydrates are known to form unique structures, largely depending on the size and valence of the cations or anions as well as the hydration number. The cation serves as the guest enclathrated in framework cavity, while a simple anion displaces the water molecule in the host framework, forming hydrogen bonds together with the neighboring water molecules. Due to this ionic characteristic, ionic clathrate hydrates have received attention in relation to the development of proton conductors. In this study, we present ionic conductivities and phase behaviors of tetraalkylammonium cation clathrate hydrates. As a result, tetrabutylammonium hydroxide clathrate hydrate shows the best performance for a solid proton conductor among the prepared tetraalkylammonium cation clathrate (ionic conductivity  $\approx 10^{-2} \text{ S}\cdot\text{cm}^{-1}$ , melting point  $\approx 20^\circ\text{C}$ ).