# Thermal and ionic conducting properties of ionic clathrate hydrates: A potential proton conductor

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The ionic clathrate hydrates are known to create numerous clathrate structures by hydrophobic inclusion of cations into confined cage space and hydrophilic incorporation of relatively small monatomic anions with hydrogen-bonded water framework, or both hydrophilic and hydrophobic incorporations of polyatomic anion with hydrophilic and hydrophobic components. The combined anion makes the protons in host water lattice more mobile. Accordingly, the ionized host framework can serve as the path for promoting proton transportation. The proton conduction largely depends on anionic species, encaged guest molecules, and cage dimension. However, relatively low conductivity and melting temperature of ionic clathrate hydrates hinders real applications to proton conductors. In this study, we measured the thermal stability and ionic conductivity of various ionic clathrate hydrates. For enhancement of the conductivity and melting point, we intentionally attempted synthesis of the double clathrate hydrates introducing secondary guest molecules. The newly synthesized clathrate hydrates show desirable features as a potential protonic conductor.