

### Electrochemical Stability of Ionic Clathrate Hydrate for Energy devices

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The ionic clathrate hydrates(ICHs) have been researched as potential proton-conducting solid electrolyte of electrochemical devices. We investigated the electrochemical stability of various ICHs depending on the ionic concentration, crystal structure, cage occupancy, the type of cation, and temperature by measuring the width of its electrochemical potential window from Linear Sweep Voltammetry(LSV). Our experiments were conducted with following seven Tetraalkylammonium hydroxide hydrates which are representative ionic clathrate hydrates:  $\text{Me}_4\text{NOH}\cdot 5\text{H}_2\text{O}$ ,  $\text{Me}_4\text{NOH}\cdot 7.5\text{H}_2\text{O}$ ,  $\text{Me}_4\text{NOH}\cdot 10\text{H}_2\text{O}$ ,  $\text{Bu}_4\text{NOH}\cdot 28.3\text{H}_2\text{O}$ ,  $\text{Bu}_4\text{NOH}\cdot 32.3\text{H}_2\text{O}$ ,  $2\text{THF}\cdot \text{Pr}_4\text{NOH}\cdot 32\text{H}_2\text{O}$  and  $2\text{Me}_4\text{NOH}\cdot \text{Pr}_4\text{NOH}\cdot 30\text{H}_2\text{O}$ . As a result,  $\text{Me}_4\text{NOH}\cdot 5\text{H}_2\text{O}$  showed the highest electrochemical stability with a greatly wide potential window of which the value was more than 8.3V at  $-24^\circ\text{C}$ .