Superprotonic Solid Acid Compounds for Sustainable Energy Technologies

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The compound CsH_2PO_4 offers several advantages as a proton conducting electrolyte for electrochemical energy technologies. This material is a member of the general class of compounds known as solid acids or acid salts, in which polyanion groups are linked together via hydrogen bonds and monoatomic cations provide overall charge balance. Several solid acids display a superprotonic transition to a structurally disordered phase of high conductivity at which the conductivity jumps by 3-5 orders of magnitude and the activation energy for proton transport drops to a value of ~ 0.35 eV. In the case of CsH_2PO_4 the transition occurs at 228 °C and the conductivity rises to ~ 10^{-2} S/cm at 240 °C, enabling device operation at temperatures between 230 and 260 °C. We present here an overview of the proton transport characteristics of CsH_2PO_4 [1] and the current status of electrochemical technologies based on these electrolytes. These technologies include hydrogen fuel cells [2,3], direct methanol fuel cells [4], and ammonia-to-hydrogen electrochemical conversion cells [5].

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