# Hydroborates as solid electrolytes for all-solid-state batteries

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Hydroborates are a promising alternative class of solid electrolytes that combine liquid-like ionic conductivity with high electrochemical stability, high thermal stability and favorable mechanical properties [1-4]. Using the mixed-anion compound $Na_4(B_{12}H_{12})(B_{10}H_{10})$ as electrolyte, we realized stable cycling of 3 V all-solid-state battery using sodium metal as anode and $NaCrO_2$ as cathode. We achieved a capacity of 85 mAh/g at C/20 and 80 mAh/g at C/5 with more than 90% capacity retention after 20 cycles at C/20 and 85% after 250 cycles at C/5 [1,2]. Here, we elucidate the conduction mechanisms of these electrolyte and related compounds. We show that the fast sodium ion diffusion is correlated to the rotational and librational motions of the anions, resulting in a complex temperature dependence of the conductivity [5,6]. Based on this observation we discuss design rules to achieve high ionic conductivities in this class of materials.

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