Synthesis of asymmetric sodium spiroborate monomers for single-ion sodium conducting polymer electrolytes

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Single-ion conducting polymer electrolytes (SICPEs) are promising new materials which can reduce dendrite formation and increase charging speeds in sodium ion batteries. In these polymer electrolytes, the anion is chemically bonded to the polymer matrix, leaving only the cation mobile. Like in most alkaline metal batteries, the most explored salts are highly fluorinated, complicating recovery and recycling of the materials due to safety and environmental hazards. Here, we aim to design fluorine-free spiroborate monomers which can then be polymerized into SICPEs for use in sodium batteries. This is accomplished by first synthesizing asymmetric anions. Various methods are explored to favor the formation of the asymmetric anion over the symmetric versions. The anions are then modified with methacrylate to render them polymerizable. The spiroborate monomers are copolymerized with polycaprolactone to form polymer electrolytes. Results will include the optimized synthesis and polymerization conditions of the monomers as well as their electrochemical properties and performance in SICPE solid state sodium batteries. The salts and monomers are characterized by nuclear magnetic resonance spectroscopy (NMR) and mass spectroscopy (MS). These findings can contribute to the development of new polymer electrolyte materials for safer and more sustainable sodium battery technologies.