Revisiting spiroborate salts beyond bis(oxalate) borate as fluorine free electrolytes for sodium ion batteries.

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Design to recycle is a demanding requirement for next generation secondary alkaline-ion batteries. Fluorine containing compounds in both electrodes and electrolyte complicate recycling and increase environmental risks due to the possible formation of hazardous substances such as HF and PFAs. Younesi and co-workers introduced bis(oxalate)borate electrolytes for sodium ion batteries (SIB) as a promising route toward fluorine free high performance electrolytes[1]. However, this suffers from limited solubility in most solvents and a tendency to form a resistive solid electrolyte interphase (SEI).

Nevertheless, it opens for the possibility to explore a wide range of related compounds by modifying the ligands at the boron centre in order to tailor electrolyte properties. While many spiroborate compounds have previously been investigated for Li ion batteries, they were primarily considered as film forming additives rather than as electrolyte salts. In this study, we analyse several fluorine free spiroborate electrolytes based on diol or hydroxy acid ligands and analyse their physicochemical and electrochemical properties as well as their electrochemical performance in sodium-ion full cells. The salts were synthesized using an adapted, simple azeotropic distillation approach. Using bis(salicylato)borate as a case study, we demonstrate that substitution on the aromatic ring not only shifts the electrochemical stability window but also dramatically improves salt solubility.

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