**Fluorolytic sol-gel route and electrochemical properties of AFeF3 (A=Na,K,NH4) perovskite nanoparticles and polyanionic transition metal phosphate fluorides**

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Li-ion batteries (LIBs) are omnipresent in consumer electronics and are seen as the most promising technology for electric vehicles. Na-ion batteries (NIBs) have emerged as viable and cheaper alternatives for stationary applications where Li-ion batteries are too expensive. However, the larger size of sodium ion compared to lithium makes traditional positive materials for LIBs not always suitable for the reversible insertion of sodium ions.

3d-transition metal fluorides, such as FeF3, have drawn attention as NIBs and LIBs positive electrode material due to their ability to deliver high potential thanks to the high polarity of the metal-fluorine bond. However, the insulating character of these highly ionic materials in practice leads to high polarisation and slow insertion kinetics [1-3]. Moreover, since the positive electrode in current LIBs and NIBs is the reservoir of alkali ions, metal fluorides are not applicable in alkali-ion technology against a carbonaceous anode without pre-lithiation/sodiation [1].

Therefore, in order to solve these problems, here we introduce a fluorolytic non-hydrolytic solution synthesis of AFeF3 (A=Na,K,NH4) perovskite nanoparticles. The perovskite AFeF3 materials show a reversible electrochemical activity of 1Na or 1Li per iron with low polarisation and excellent capacity retention. The unexpected reversible insertion of both sodium and lithium ions, studied through ex-situ and operando X-ray diffraction measurements, is attributed to a kinetic stabilization of corner-shared cubic (Li,Na)xFeF3 frameworks along the cycles involving low volume change without high thermodynamic cost as supported by a polymorphism theoretical analysis [4-5].

In this report, it will also be shown how the fluorolytic non-hydrolytic synthesis route can me extended to fluorine-containing polyanionic compounds with the general formula AaMbXcO4Fd (A= Li, Na…; M= Ti, V, Mn, Fe, Co, Ni…; X = P or S). In particular a novel non-hydrolytic fluorolytic sol-gel chemistry to tavorite-type LiFePO4F and Li2CoPO4F materials and their electrochemical characterization will be discussed [6-7]. It will be proven that the versatility of the original reported route allows to produce a variety of fluorine-containing polyanionic compounds, which are of great interest for energy storage applications.

**References**

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