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Design of new cathode materialused as electrode for Li-Na-K-ion batteries

Abstract: One of the major challenges of the 21st century is our ability to solve energy-related problems caused by ever-higher consumption, demography and standardof living. It is therefore imperative to anticipate this energy demand and this in a context of sustainable development. Storage technologies are highly dependent on the materials used and it is necessary to search for new materials with advanced properties that are also ecological and economical. Despite the high performance of lithium-based materials, its cost is driving scientists to develop alternative systems based on sodium and potassium, which are widely abundant in the earth's crust.
Manganese based oxide materials are promising cathodes for alkaline ion batteries due to their high energy density, low-cost and low-toxicity. Focusing on layered-type structures, one has to cite of course the AxMnO2 families showing interesting insertion properties in all the system based on lithium, sodium and even more recently potassium. Moreover, we notice that the system A-Mn-Oare extremely rich in term of original structures. For example, we found a new lithium rich composition Li4Mn2O5 with a disordered rock salt structure that was showing an exceptional capacity of about 300mAg/g [1]. Interestingly, the material Na4Mn2O5 has been reported with a layered type structure, different from the lithiated phase and we will discuss the relationship between the structure and insertion properties [2]. Recently we report the electrochemical activity of potassium insertion into K3MnO4 [3]. In the frame of this presentation, we will discuss our strategy and result regarding the generation of green materials for the energy storage.

References:
[1]M. Freire et al., Nature Mat.,15, (2016), 173.
[2] V. Pralong et al., under submission (2024).
[3] Sagot, A., Stievano, L., & Pralong,V. (2023). ACS Applied EnergyMaterials, 6(15), 7785-7789