Electrode materials for Li-ion and Na-ion batteries prepared by hydrothermal and spray drying methods

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Li-ion batteries are widely used energy storage; however they are limited by availability of materials, price and safety. Regarding economic reasons and preservation of Earth resources, it is necessary to anticipate the lithium substitution by more abundant elements. Sodium-ion batteries are potential candidates to replace Li-ion batteries because the sodium sources are "unlimited", attainable at low-cost, and geographically distributed. The electrode materials optimization plays a key role in the development of advanced rechargeable batteries. Indeed, the electrode properties have a great influence on the safety, performance and durability of alkali-ion batteries [1].

Spray-drying and hydrothermal (solvothermal) methods are very appropriate to obtain electrode materials for alkali-ion batteries [2-4]. Both techniques are easily adaptable to new materials and can be applied to a wide range of potential electrode materials. These two synthesis methods, suitable for a large-scale industrial production, allow forming spherical aggregates at low temperatures. A variety of synthetic conditions can be tested including different calcination temperatures, dilution of the starting slurry, milling the material in the dry state and in various nonaqueous solvents. In addition, it is possible to mix the precursors with conductive additives during the material synthesis, leading to carbon/active material composites blends at the nanometric level [3].

In this presentation, we report the synthesis and the study of the iron-based phosphate materials ($Na_{1.25}Ni_{1.25}Fe_{1.75}(PO_4)_3$, $Na_2Mn_{1.5}Fe_{1.5}(PO_4)_3$ [4], Na_2FePO_4F...) for Li/Na-ion batteries. Mössbauer spectroscopy analyses was combined with other characterization techniques (X-ray diffraction, SEM, TEM, impedance spectroscopy, etc.) to study and investigate the structural, magnetic and electrochemical properties of electrode materials prepared by spray-drying and hydrothermal synthesis methods.

References

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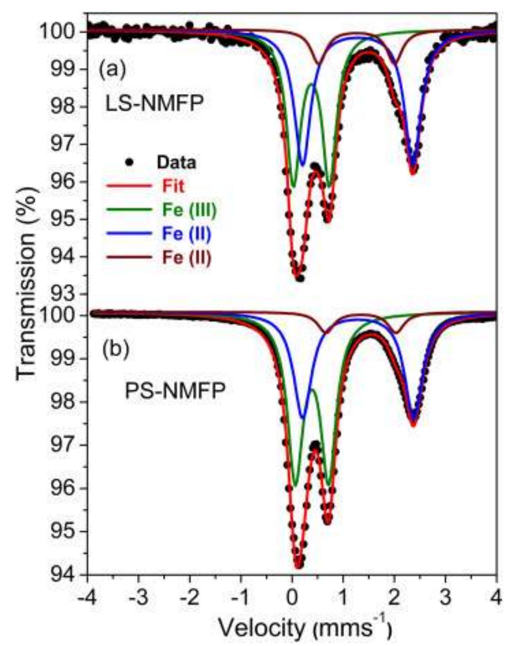

Fig. 1. Room temperature Mössbauer spectra of $Na_2Mn_{1.5}Fe_{1.5}(PO_4)_3$ powder synthesized by hydrothermal method at 220 °C via laboratory scale (6 h) and pilot scale (0.5 h) syntheses [4].

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