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Innovative hybrid high voltage electrodes based on LMNO/LFP materials for lithium ion batteries

D. Versaci[a], R.Colombo[a], B. Rana[b], N. Cortes Felix[c], D. Kopljar[b], C.Francia[a], Silvia Bodoardo[a]

[a] *Electrochemistry Group, Department of Applied Science and Technology (DISAT), Politecnico di Torino, C.so Duca degli Abruzzi 24, 10129 Torino (Italy)*
[b] *Institute of Engineering Thermodynamics/Electrochemical Energy Technology, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR, German Aerospace Center), Pfaffenwaldring 38-40, 70569 Stuttgart (Germany)*
[c] *Johnson Matthey Technology Centre (JM), Blounts Court Sonning Common, RG4 9NH, Reading (England)*

e-mail presenting author: daniele.versaci@polito.it

Nowadays the markets of electric vehicles (EV) and energy storage devices are fast increasing pushing a constant increase in the demand for greener and more sustainable power sources. In particular, for EVs applications, batteries guaranteeing long cycle life combined with high specific energy and high power density are needed. To increase the specific energy, one solution is to increase the cell voltage and the capacity. For this reason, combine high voltage cathode, *i.e.* LMNO (Lithium Manganese Nickel Oxide), together with high capacity anodes, *i.e* silicon, can be an interesting solution. Unfortunately, LNMO suffers easy cation leaching during cycling, in particular at high C-rates. The present work shows results achieved within HYDRA H2020 project based on the synthesis of new blended materials combining LMNO and LFP (Lithium Iron Phosphate) in order to match their inherent positive characteristic to get better performing electrodes. LFP was chosen because of its outstanding thermal and electrochemical stability, as well as its Li-redox activity at a relatively high voltage [1][2][3]. Therefore, the presence of the LFP should increase the cycling stability of the LMNO, especially at higher current rates.

In order to get a homogeneous coating of LFP particles on the LMNO surface, we used ball milling treatments modifying all parameters, such as frequency, time, and weight percent of LFP. The blended active materials were thus characterized from a morphological and structural point of view with FESEM and XRD analysis, and electrochemical characterization: galvanostatic cycling and cyclic voltammetry studies. The results obtained are showing that the mixing through ball milling does not significantly damage the structure of the two pristine materials and ensures a homogeneous dispersion of LFP particles which partially cover the LMNO particles. The electrochemical data confirm that both materials actively contribute to the capacity of the blended electrodes.

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