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Positive effects of a particular type of microwave-assisted methodology on the electrochemical properties of olivine Li*M*PO4 (*M* = Fe, Co and Ni) cathode materials

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ABSTRACT

Pure Li*M*PO_4 (*M* = Fe, Co and Ni) cathode materials have been synthesized with an ordered olivine structure using a concurrent solvothermal process involving low-level and long-time microwave applications using ethylene glycol as a reaction medium. The influences of this unusual microwave approach have been investigated in detail in terms of the structural and electrochemical properties of the materials produced, and the findings have been compared with those obtained by conventional methods. The Rietveld refinement reveals that all powder products have the same orthorhombic olivine structure in the *Pnma* space group, that lithium ions are predominantly occupied at the octahedral M1 [100] site, and that the Fe, Co and Ni transition metal ions reside at the octahedral M2 [010] site. It has also been found that anti-site disorders remain somewhat limited, albeit slightly higher in the case of the Li - Ni couple. $LiFePO_4$ exhibits good long-term electrochemical properties. $LiCoPO_4$ and $LiNiPO_4$ cathodes exhibit qualitative cyclic stability performances in their own categories. At the end of 500 cycles, $LiFePO_4$ retained 97.6% of the initial capacity value, while $LiCoPO_4$ was able to maintain only 52.8% at the end of the 50^{th} cycle. In particular, this extraordinary microwave technique mediates stable and low-defect crystal formation, which has a remarkable effect on the electrochemical stability characteristics of the material. Thus, this work provides a positive contribution for advanced energy storage applications.

Keywords: Li–ion battery; Olivine phosphate; Cathode material; Low-level and long-time microwave approach; Heating efficiency