

Optimization of PVDF – LiFePO₄ porous composites manufactured by twin-screw extrusion for energy storage technologies

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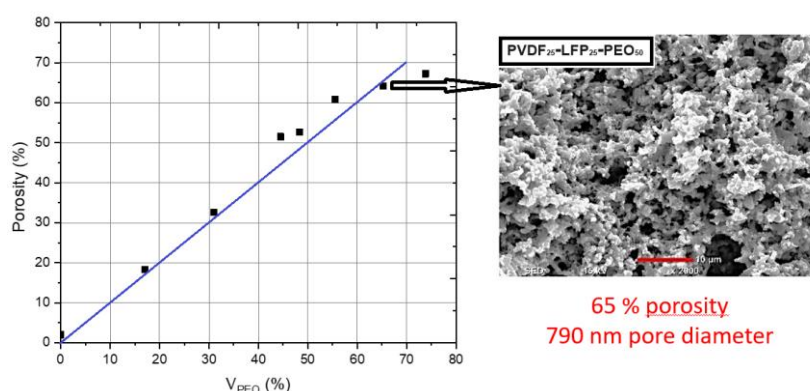
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Résumé : Large-scale energy storage is of high interest for the deployment of renewable energy sources and can be achieved with traditional redox flow batteries (RFB). New RFB concepts with improved storage capacity has been recently proposed using solid boosters such as LiFePO₄ (LFP) in the electrolyte tanks [1-2]. This communication reports about the preparation of such solid boosters in granule form using ternary PVDF / LFP / PEO formulations processed by twin-screw extrusion followed by water leaching. Immobilization of LFP particles by PVDF is expected while producing porous structures by PEO leaching into water to maximise the electrolyte accessibility and electrochemical reactivity of LFP particles [3]. Specific formulations are targeted to favour the formation of co-continuous PVDF and PEO phase morphologies [4]. A first set of experiments confirm the efficiency of this industrial strategy over a broad range of compositions with a perfect immobilization of LFP particles by PVDF together with a selective removal of the PEO phase. PVDF / LFP porous composites with up to 50 wt-% LFP and a controllable porosity up to 65 % can be easily achieved. Complex microstructures are depicted with submicronic pore sizes. Remarkable electrochemical activity and durability of these porous granules in flow conditions with redox agents are also attested. Recent set of experiments were designed to maximize the amount of LFP particles into porous granules and reveal / modify the microstructure of porous granules. In particular, the importance of thermodynamic and kinetic effects on the microstructure of porous granules is explored based on the measurement of wetting coefficients. A strong impact of the PVDF / PEO viscosity ratio is observed with the generation of surprising morphologies that facilitate the reactivity of LFP particles. Finally, some perspectives of this work will be presented in the field sodium-based redox flow batteries and other advanced applications.



Evolution of the porosity for PVDF / LFP composites as a function of the PEO volume fraction in ternary formulations and corresponding morphologies for porous composites with 65 % porosity.

Références :

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