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TOWARDS HIGH-ENERGY, LOW COST LITHIUM-ION BATTERIES

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The employment of porous current collectors in lithium batteries represents a good strategy to increase their specific energy and power. Embroidered current collectors, consisting of a flexible three-dimensional (3D) metal mesh formed by wires, allow the insertion of higher amounts of electrode material than metal foils. The 3D metal mesh structure enhances the mechanical stability and electrical conductivity of the electrodes. Moreover it enables the accommodation of the volume changes occurring during lithiation in some electrode materials, thus improving their long-term cycle performance. Up to now electrode formulations were mainly optimized for conventional planar current collectors. Slurry compositions, consisting of a mixture of electrode materials, conductive additives and binder agents were investigated to obtain thin electrodes with high mechanical and electrochemical performance. The employment of unconventional current collectors requires new optimizations of the electrode formulations to enhance the electrochemical performance of the electrodes. The electrode composition (amount of conductive additives and binders), homogeneity and dispersion stability, affects the electrochemical performance of the electrodes (capacity, rate capability, cycle life). In this work, we present investigations of the rheological properties of water based $LiFePO_4$ as a tool for the optimization of low-cost electrode manufacturing using embroidered current collectors. The information extracted from the rheological measurements (long-term physical stability, flowability and gel strength) is related to the electrochemical behavior of the electrodes and used to optimize electrode formulations. The results show $LiFePO_4$ electrodes with double energy density, 220 Wh/kg and the same volumetric energy density, 220 Wh/L, than conventional $LiFePO_4$ electrodes.

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