Electrode fabrication for lithium-ion batteries for electric vehicle application via a dry process

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Résumé

Lithium-ion batteries have become the main energy storage technology for consumer electronics and electric vehicles (EV). However, despite their widespread use, there are still way of improvement of these batteries. Conventional lithium-ion battery cathodes are fabricated by coating organic solvent-based slurries onto aluminum current collectors. These slurries contain an electrochemical active material, a conductive carbon, a binder, and a solvent (to form a binder solution). A widely used binder/solvent used in Li-ion batteries is polyvinylidene difluoride (PVDF), dissolved in N- methylpyrrolidone (NMP). Recently, there has been a growing interest in developing new manufacturing processes for electrode films that are more environmentally friendly and economically viable. One such approach is to eliminate the use of NMP, which is a hazardous solvent and whose evaporation, recovery and recycling has a high energetic and cost for battery manufacturers.1-2
Electrode fabrication processes that dispense completely the use of any solvent are known as dry processes. To fabricate electrodes with this method, we first mix the powder components using a paddle mixer. Then, the electrode mix powder is fed to an electrostatic spray gun. Then, a high voltage is applied to the powder, which then gets ionized, forming a cloud of charged particles. The charged particles are then accelerated towards the substrate (which is the metallic current collector grounded to the earth), where they form a uniform and continuous coating layer. Once the electrode coating is formed, we calendar the electrode using high temperature rolls to form a consolidated electrode with the porosity we determined.

This change in the manufacturing process can impact the electrode characteristics, (homogeneity of distribution, porosity, adhesion, and cohesion). These characteristics, in turn, can affect the electrochemical performance of the electrode, such as the capacity, cycle life, and rate capability.3-7

In this work, we use electrostatic spraying to fabricate anodes. Our focus is on characterizing all relevant properties, including electrochemical, mechanical and morphology, to compare our electrodes with reference electrodes who are fabricated with traditional slurry method. Our investigations suggest that our fabrication methods are viable alternatives for producing electrodes with comparable properties to those fabricated using traditional

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methods (even transposable to cathodes). Overall, our work provides insights into new and promising methods for fabricating high-quality electrodes with high mass loadings for use in a variety of electrochemical applications such as EVs.

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