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Evaluation of processing strategies for the manufacturing of Li-ion battery positive electrodes using non-solvent extrusion process

A. De Simone, E. Abouddrar, S. Chazelle, L. Gerson, B. Chavillon, E. Mayousse, D. Sotta, F. Rouillon, S. Patoux

*CEA, Department for Electrical and Hydrogen Transportation (LITEN/DEHT/STB/L2PC),
17 avenue des Martyrs, F-38054 Grenoble Cedex 9, France
e-mail address: dane.sotta@cea.fr*

Session 2: Electrode production

Lithium-ion batteries have known a considerable growth as energy storage devices in portable electronics applications, but also in electrified vehicles and stationary systems over the last few years. Cell manufacturers are looking for technical solutions to further reduce the costs of production lines. One of the critical steps is the production of positive and negative electrodes, i.e. the preparation of slurries and coating on current collectors. These complex stages involve the use of solvents that have to be removed during an energy-consuming drying phase. This is of particular importance for the production of positive electrodes where state-of-the-art industrial process is based on the use of carcinogenic N-methyl-2-pyrrolidone (NMP) solvent, which implies the use of safety protocols and equipment for solvent recovery and recycling.

Alternatives to this conventional manufacturing route have been proposed such as extrusion, a well-known process in the plastics industry. Extrusion allows to work with viscous matrices by combining the mixing (homogenisation, dispersion) and film forming (flat die extrusion, lamination) in a continuous way. Generally, the use of solvents is very limited or even eliminated, which makes it an innovative process compared to the standard one. Its industrialisation in the field of batteries therefore seems to be relevant because it combines a continuous process, a small footprint and limited costs.

Here we report the evaluation of two different strategies for the production of porous cathodes for Li-ion batteries without the need of NMP. In one hand, the use of small amount of water in the electrode composition is evaluated and its impact on battery lifetime is characterized. On the other hand, solid blowing agents are directly added in the formulation to create pores by thermally activated decomposition reactions. The impact of these new processes on the electrode morphology is thoroughly characterized with the help of scanning electronic microscope, helium pycnometer and mercury intrusion porosimeter. Electrochemical performances of promising samples are evaluated after assembly of coin and pouch cells. Finally, optimization routes are proposed toward energy-saving and dry processes for electrode manufacturing.