Innovative assembly of gelled system for Lithium ion batteries

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CEA-Liten and Solvay have launched a large R&D program for developing gelled lithium batteries operating at room temperature. Composed of gelled electrodes and membrane, each component already contains the electrolyte when elaborated, suppressing therefore the electrolyte filling step after assembly. After having developed the preparation process of a gelled membrane containing *in situ* synthesized Si-O bonds and retaining electrolyte, CEA-Liten and Solvay have then imagined an innovative assembly in order to overcome a possible side reaction between the Li salt, the additives and the reactants used to promote the sol-gel reaction during the membrane synthesis.

The principle is rather simple: the total amount of Li salt (or additive) for reaching their aimed concentration in the electrolyte is provided by diffusion from at least one of the 2 electrodes. In this paper**, is given the example of $LiPF_6$ salt provided by the NMC based positive electrode to the full Graphite/NMC system for reaching a final concentration of 1M.**

The gelled membrane is prepared by sol-gel reaction for retaining the carbonate based electrolyte solvents without any salt, i.e. EC:PC 1:1 + 2wt.% VC. The gelled graphite based negative electrode is also elaborated for trapping the electrolyte without Li salt. The gelled NMC based positive electrode is on the other hand prepared with an "over salted" electrolyte, with a $LiPF_6$ concentration of 2.4 M, (see Figure 1a). The concentration is determined taking into account the electrolyte volumes of the pellet-shaped gelled electrodes and membrane used for coin cells.

After assembly, the cells are then stored at 45°C for 24 hours in order to favor the Li salt diffusion in all the gelled system through the interface electrodes/membrane (See Figure 1b).

Electrical performances of such an assembly were evaluated at room temperature. Cycling results at room temperature show that the full gelled system works properly with promising performances at different C-rates (See Figure 2).

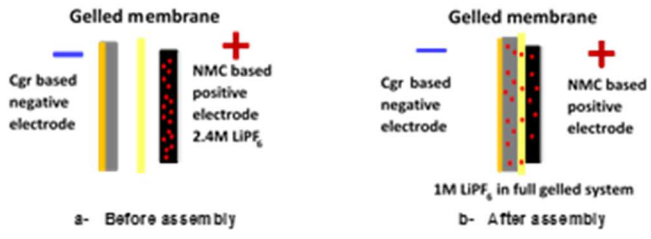

Figure 1: Localization of lithium salt before and after assembly

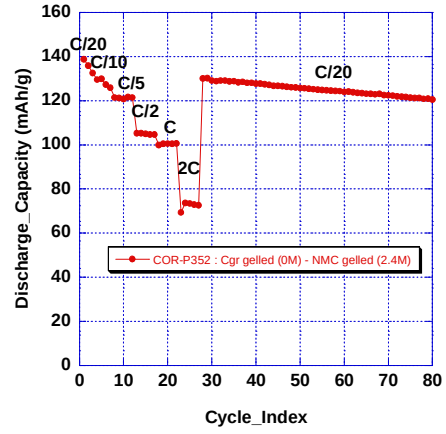

Figure 2: Cycling results obtained on coin cell after diffusion of $LiPF_6$ through the full electrochemical system