Testing Report on MTI' Al-Clad Coin Cell Case

Knowledge Preparation

Typical charge-discharge curve of a rechargeable lithium-ion battery based on $LiCoO_2$ - MCMB is listed in figure 1.

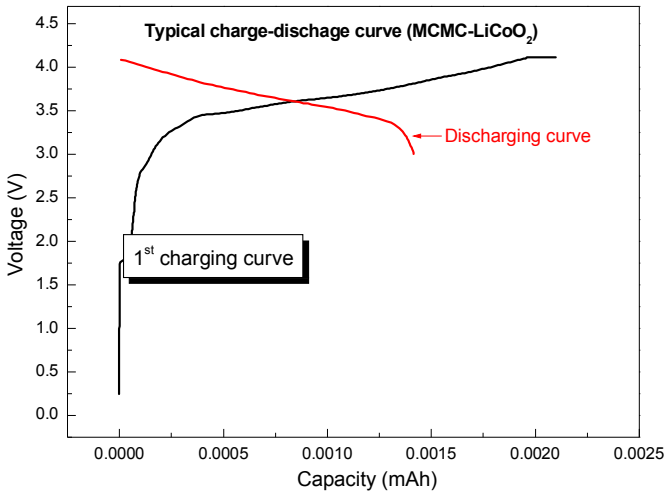

Fig. 1 Typical charge-discharge curve of a lithium-ion battery

Problem

However, common type coin cell cases cannot be charged to a voltage higher than 3.5 V, as shown in the figure 2.

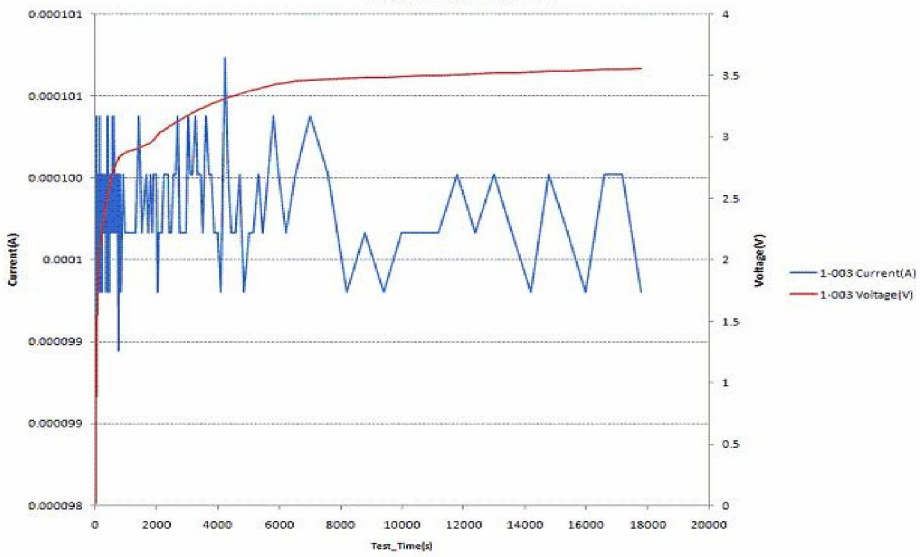

Fig. 2 Charge curve with common type coin cell cases

Problem identifying

MTI's tech group mentioned customer's feedback to us and we managed to identify what factor results in this problem.

After excluding that the problem originated from the electrode or electrolyte, we suspected that this problem may be caused by the bottom can which is made of stainless steel and aimed at primary lithium

batteries (operating voltage < 3.5 V). For applications using secondary lithium-ion batteries, however, the normal charge-discharge voltage is between 2.5 and 4.2 V, or even higher, such as 5.0 V, for research of high voltage cathode materials.

We designed a method to check the different coin cell cases with a diagram listed in figure 3, by charging and holding the bottom can at designated voltage (3.0 V, 3.5 V, 4.0 V, 4.5 V, 5.0 V, 5.5 V and 6.0 V) for 2500 seconds, and observing the current change with time. The construction of the testing cell: Bottom Can→PP separator→Lithium Metal→SS Spacer→Spring→PP sealing→Top Cap. The electrolyte system used in this test is the standard 1.0M $LiPF_6$-3EC:7DMC which is known to have an oxidative stability versus lithium metal between 5.5 and 6.0 V, and therefore can be used to investigate the anodic stability of the coin cell parts, at least to 5.5 V.

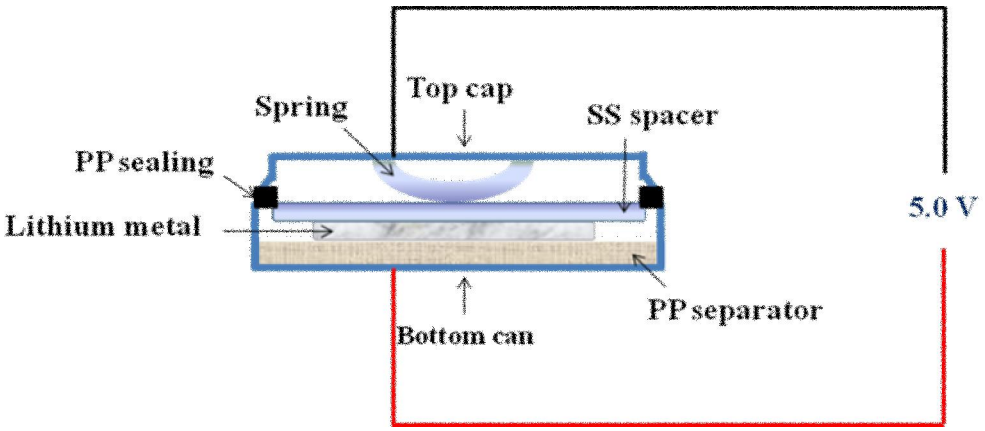

Fig. 3 The testing diagram

Testing

The current-time data are listed in figure 4 and figure 5. As can be seen from the figures, the common coin cell cases (labeled as "MTI") showed increased current versus time when held at 4.0 V, due to decomposition of either the SS bottom can or the electrolyte.

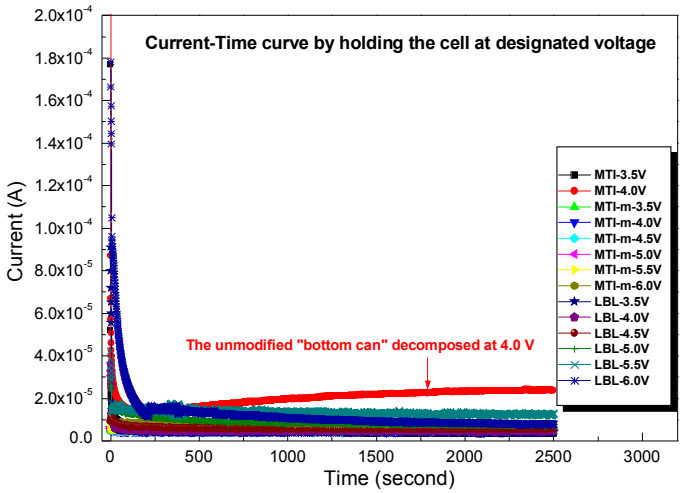

Fig. 4 Current-time of the testing cell held at different voltage

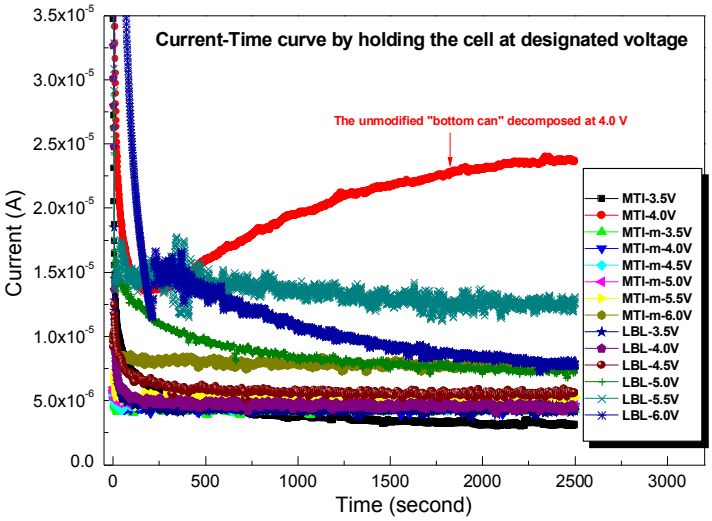

Fig. 5 Expansion of fig. 4

The coin cell cases coded with LBL has a special bottom can which is Aluminum clad on whatever metal (I don't know exactly) and could tolerate higher voltage polarization due to the passivation of the can by the electrolyte component, especially the $LiPF_6$ based electrolyte system, by forming a layer AlF_3 which is thin enough (several angstroms) to allow electron tunneling, and block the dissolution of Al^{3+} into the electrolyte.

Solution

The solution to the MTI coin cell cases is simply to coat/sputter thin layer aluminum on the stainless steel bottom can for higher voltage holding. MTI sent us three Al-coated cans after the problem was identified.

Results

The data listed in figure 4 and figure 5 showed that after coating with a layer of aluminum, the modified cases (labeled as "MTI-m", which is actually MTI's Al-Clad coin cell cases with item number **EQ-CR2032-CASE-316A**) can be charged to higher voltage such as 5.5 V, with a background current lower than 10 μA.

Conclusion

We successfully identified the coin cell cases problem and MTI's Al-clad coin cell cases work fine at **5.5V** as the data shows. Further optimization of the aluminum coating needs customer feedback and support.

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