Application News

No. SCA_300_002

Material Testing System
MCT

Compression Test for Structural Materials of Lithium-Ion Batteries by MCT

■Introduction

Since lithium-ion batteries are light and small, they are used in a wide variety of products, from mobile electronic devices such as cellular phones and notebook PCs to electric cars and hybrid cars. Their inner structural materials are subjected to external force during production processes and to pressure during use. Therefore, evaluation of strength of each structural material is important to maintain consistent quality. A strength measurement was performed on thin or minute materials among various structural materials of lithium-ion batteries. Separators are usually evaluated by a tensile test or penetration test. A compression test is also important to evaluate them because they are compressed in some processes. Active materials of approximately 10 µm in size located near the electrode need to have a certain compression strength so they will not be destroyed during the coating process. Below are the results of compression tests performed on these materials using the MCT-211 Series Micro Compression Testing Machine.

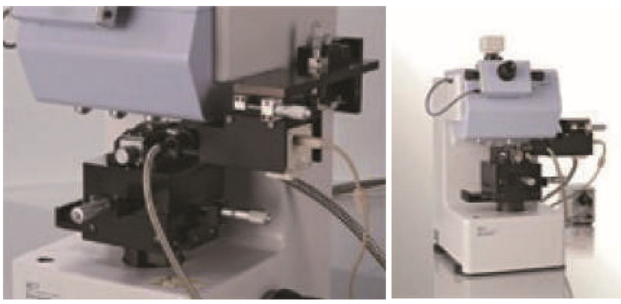

Fig. 1 External View of the MCT-211 Series (with the Side Observation Kit Mounted)

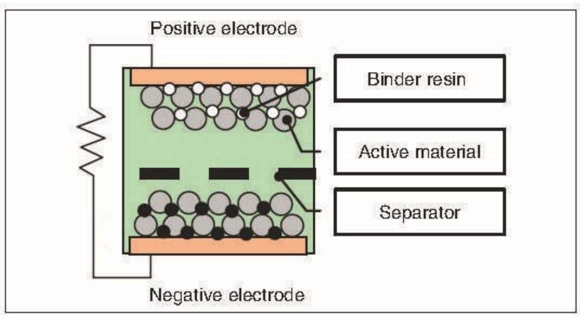

Fig. 2 Structure of Lithium-Ion Battery

■Compression Test on Separator of Lithium-Ion Battery

Table 1 shows the three types of specimens used for the measurement. Table 2 shows accessories used in the test and test conditions. Fig. 3 shows the conceptual diagram of the measurement. Table 3 shows the results of the compression tests on the three types of specimens. The specimens were evaluated by a compression rate where the same test force was applied. The results clearly show the difference among the three types. Fig. 4 is a graph indicating the test force - displacement relationship of each specimen. The inflexion point of specimen 2 is at around 10 mN (pressure of approximately 5 MPa), indicating that applying too much compression pressure causes plastic deformation to the separator.

Table 1 Specimens

1) Specimen Name	Separator		
2) Specimen Number	1	2	3
3) Thickness	20 µm	20 µm	10 µm

Table 2 Test Conditions

1) Upper Indenter	Flat indenter (with a diamond tip), 50 µm dia.
2) Test Mode	Load-unload test
3) Test Force (mN)	50
4) Loading Rate (mN/sec)	2.2
5) Holding Time (sec)	0
6) Test Method	A thin layer of liquid glue was applied to a glass plate, the separator was bonded to it, and a compression test was performed using the upper indenter. (See Fig. 2.)

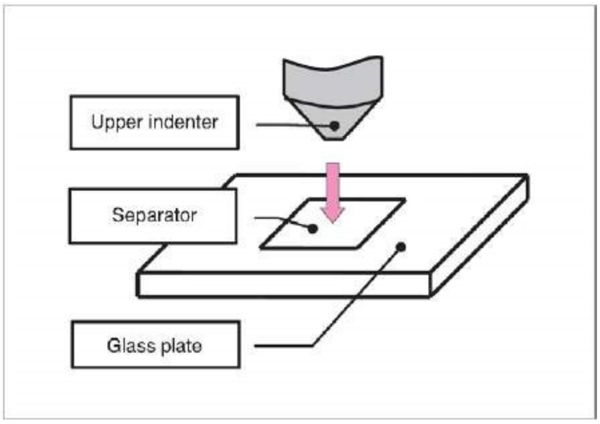

Fig. 3 Conceptual Diagram of Measurement

Table 3 Test Results

Specimen Name	Specimen Number	Maximum Force (mN)	Compression Variation (µm)	Compression Rate (%)
Separator	1	49.9	3.651	18.3
	2	49.9	3.371	16.9
	3	50.0	1.038	10.4

Note: The compression rate was calculated by the following calculation formula.
Compression rate (%) = (compression volume)/(thickness) × 100 (%)