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**Electrochemical performance test of lithium nickel
cobalt manganese oxide - Test method for discharge
plateau capacity ratio and cycle life**

镍钴锰酸锂电化学性能测试

放电平台容量比率及循环寿命测试方法

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Electrochemical performance test of lithium nickel cobalt manganese oxide - Test method for discharge plateau capacity ratio and cycle life

1 Scope

This Standard specifies the test method for discharge plateau capacity ratio and cycle life for lithium nickel cobalt manganese oxide of lithium-ion battery cathode material.

This Standard applies to the testing of discharge plateau capacity ratio and cycle life for lithium nickel cobalt manganese oxide of lithium-ion battery cathode material.

2 Normative references

The following documents are indispensable for the application of this document. For the dated references, only the editions with the dates indicated are applicable to this document. For the undated references, the latest edition (including all the amendments) are applicable to this document.

GB/T 18287-2013 General specification of lithium-ion cells and batteries for mobile phone

3 Reagents and materials

3.1 Lithium nickel cobalt manganese oxide: D_{50} is $7\ \mu\text{m} \sim 15\ \mu\text{m}$. The specific surface area is $0.2\ \text{m}^2/\text{g} \sim 1.0\ \text{m}^2/\text{g}$. The sampling amount is $2.0\ \text{kg} \sim 5.0\ \text{kg}$.

3.2 Graphite anode: D_{50} is $12.0\ \mu\text{m} \sim 20.0\ \mu\text{m}$. The discharge specific capacity of the first cycle is $\geq 320.0\ \text{mA} \cdot \text{h/g}$. The charge-discharge coulombic efficiency of the first cycle is $\geq 88.0\%$.

3.3 Lithium-ion battery diaphragm: Polyolefin porous diaphragm. Porosity $35.0\% \sim 60.0\%$; air permeability $300\ \text{s}/100\ \text{mL} \sim 700\ \text{s}/100\ \text{mL}$; average pore size $\leq 1.0\ \mu\text{m}$; thickness $9.0\ \mu\text{m} \sim 32.0\ \mu\text{m}$; length $720\ \text{mm} \pm 1.0\ \text{mm}$; width $47\ \text{mm} \pm 0.5\ \text{mm}$.

3.4 Lithium-ion battery electrolyte: Lithium-ion battery electrolyte consisting of

4 Instruments and equipment

- 4.1** Electronic balance: The range is 5000 g, accurate to 0.1 g.
- 4.2** Spiral micrometer.
- 4.3** Ruler: Made of stainless steel. The range is 100 cm, accurate to 0.5 mm.
- 4.4** Vacuum mixer.
- 4.5** Lithium battery pole piece coating machine.
- 4.6** Pole piece punching machine: Punching die size is $\phi 50$ mm ~ $\phi 100$ mm.
- 4.7** Slitting machine.
- 4.8** Roller machine.
- 4.9** Adjustable slitting machine.
- 4.10** Ultrasonic welder.
- 4.11** Spot-welder.
- 4.12** Winding machine.
- 4.13** Battery flat press.
- 4.14** Aluminum-plastic film heat sealing machine.
- 4.15** Argon glove box: Water vapor and oxygen content are not more than 0.0005%.
- 4.16** Injector: 20 mL.
- 4.17** Vacuum oven.
- 4.18** Electric blast drying oven.
- 4.19** Lithium-ion battery electrochemical performance tester.
- 4.20** Banister brush.
- 4.21** Rubber pipette bulb.
- 4.22** Oil-free vacuum pump.

the vacuum mixer in stages for mixing and stirring, so that various materials are uniformly mixed.

5.2.2.2 During the whole process of mixing and stirring, the temperature of the positive electrode slurry is controlled below 40 °C; and the viscosity is controlled at 6000 mPa • s ~ 10000 mPa • s. Finally, after slow stirring, vacuum is applied; and the slurry is discharged to enter the next process.

5.2.3 Coating

5.2.3.1 Coating shall be carried out under environmental conditions of relative humidity $\leq 30.0\%$ and temperature $\leq 35\text{ }^{\circ}\text{C}$. The instruments and equipment used shall be clean.

5.2.3.2 USE a lithium battery pole piece coating machine (4.5) to uniformly coat the mixed positive electrode slurry on both sides of an aluminum foil (3.12). USE a spiral micrometer (4.2) to measure the thickness of the coated positive plate.

5.2.3.3 The preparation process of the positive plate coating is strictly controlled. The baking temperature at the time of coating shall not be higher than 130 °C. The thickness shall be consistent. The test data is recorded.

5.2.4 Positive plate preparation

Positive plate preparation shall be carried out under environmental conditions of relative humidity $\leq 30.0\%$ and temperature $\leq 30\text{ }^{\circ}\text{C}$. The instruments and equipment used shall be clean. USE a slitting machine (4.7) to slit the coated positive plate. Then the dressings in the L1, L3, L4, and L6 areas of the positive plate are scraped off into blank areas. The positive plate's size and specification are shown in Figure 1 and Table 1. The positive plate is placed in an oven and protected with nitrogen (3.19); and baked and dried at a temperature ranging from 110 °C ~ 120 °C for 10 h ~ 12 h. Then, USE a roller machine (4.8) to roll the positive plate. The positive plate after rolling shall be flat; and after being folded, shall not be broken or deformed, and no powder is removed. Then USE an adjustable slitting machine (4.9) to slit into positive plates with a length of 362.0 mm and a width of 42.0 mm. Each positive plate is weighed using an electronic balance; and the net weight of lithium nickel cobalt manganese oxide in each plate is calculated, numbered and recorded one by one. At the position in the left side of the L1 area and aligned with the L4 area, the positive electrode tab (3.14) is welded to the aluminum foil using an ultrasonic welder (4.10); see Figure 2.

portions). Then DISPERSE and stir until the CMC is completely dissolved into the deionized water;

- The weighed carbon black conductive agent is added to the vacuum mixer for mixing and stirring, so that various materials are uniformly mixed;
- The weighed graphite is gradually added to the vacuum mixer in stages for mixing and stirring, so that various materials are uniformly mixed;
- ADD SBR for slow stirring until completely dispersed.

5.3.2.2 During the whole process of mixing and stirring, the temperature of the negative electrode slurry is controlled below 40 °C; and the viscosity is controlled at 1500 mPa • s ~ 3000 mPa • s. Finally, after slow stirring, vacuum is applied; and the slurry is discharged.

5.3.3 Coating

5.3.3.1 Coating shall be carried out under environmental conditions of relative humidity $\leq 50.0\%$ and temperature ≤ 35 °C. The instruments and equipment used shall be clean.

5.3.3.2 USE a lithium battery pole piece coating machine to uniformly coat the mixed negative electrode slurry on both sides of a copper foil (3.13). USE a spiral micrometer to measure the thickness of the coated negative plate.

5.3.3.3 The preparation process of the negative plate coating is strictly controlled. The baking temperature at the time of coating shall not be higher than 110 °C. The thickness shall be consistent. The test data is recorded.

5.3.4 Negative plate preparation

Negative plate preparation shall be carried out under environmental conditions of relative humidity $\leq 50.0\%$ and temperature ≤ 35 °C. The instruments and equipment used shall be clean and dry. The coated negative plate is slit using a slitting machine, and then scraped. The negative electrode dressings in the L7 and L9 areas are scraped off into blank areas. The negative plate's size and specification are shown in Figure 3 and Table 2. The negative plate is placed in an oven and protected with nitrogen; and baked and dried at a temperature ranging from 100 °C ~ 110 °C for 10 h ~ 12 h. Then, USE a roller machine to roll the negative plate. The negative plate after rolling shall be flat, not deformed, and no powder is removed. Then USE an adjustable slitting machine to slit into negative plates with a length of 328.0 mm and a width of 44.0 mm. At the position in the left side of the L7 area and aligned with the L9 area, the negative electrode tab (3.15) is welded to the copper foil using a spot-welder (4.11); see Figure 4. Each negative plate is weighed using an electronic balance and

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Contact: Wayne Zheng, Sales@ChineseStandard.net

Linkin: <https://www.linkedin.com/in/waynezhengwenrui/>

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