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GB/T 43093-2023

Electrochemical performance test of lithium nickel manganese oxide - Test method for the initial discharge specific capacity and initial efficiency

镍锰酸锂电化学性能测试 首次放电比容量及首次充放电效率测试方法

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Foreword

This document was issued on 7 September 2023 by the State Administration for Market Regulation; Standardization Administration of the PRC and takes effect on 1 April 2024.

It is a GB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies when assessing a submission.

1 Scope

GB/T 43093-2023 gives the test method for the first discharge specific capacity and first charge-discharge efficiency of lithium nickel manganese oxide cathode material. LNMO is the cobalt-free high voltage spinel that the industry has pursued for years because it removes the most expensive and most contested element from the cathode; its difficulty is the 4.7 volt plateau, which oxidises ordinary electrolyte, so the first cycle loses more capacity than in other chemistries and the first-cycle efficiency is the number that most directly predicts what the material will do in a cell. The standard sets the reagents and materials, the instruments and equipment, the test procedure for assembling and cycling the half cell, the processing of the test data, the permitted differences between determinations and the test report. It took effect on 1 April 2024.

This document describes the test method for the initial discharge specific capacity and initial

charge and discharge efficiency of lithium nickel manganese oxide - lithium-ion battery positive

electrode material.

This document is applicable to the test of the initial discharge specific capacity and initial charge

and discharge efficiency of lithium nickel manganese oxide - lithium-ion battery positive

electrode material. The test method includes button-type half-cell method and button-type full-

cell method.

2 Normative References

This document does not have normative references.

3 Terms and Definitions

This document does not have terms or definitions that need to be defined.

4 Reagents and Materials

4.1 Lithium nickel manganese oxide: spinel type.

4.2 Artificial graphite negative electrode material.

4.3 Lithium-ion battery electrolyte: high-voltage resistant type, with a moisture content not

greater than 0.002%, free acid (HF) not greater than 0.005%, and electrical conductivity (25 ?C)

not less than 7.0 mS/cm.

4.4 Ethanol: industrial grade.

4.5 Binder: polyvinylidene fluoride (PVDF), battery grade, with a weight-average molecular

weight not less than 5 ? 105 and moisture content not greater than 0.10%; sodium

carboxymethylcellulose (CMC), battery grade, with a viscosity of 500 mPa ? s ~ 1,200 mPa ?

s; styrene-butadiene rubber (SBR) emulsion.

4.6 N-methylpyrrolidone (NMP): battery grade, with a purity not less than 99.9% and a moisture

5.11 Inert atmosphere (argon) glove box: with a moisture content and oxygen content not

greater than 0.0001%.

5.12 Button-type battery packaging machine.

5.13 Lithium-ion battery electrochemical performance tester: with a current and voltage full-scale accuracy of 0.1%.

5.14 Thermostat: with a temperature of 25 ?C ? 1 ?C and a relative humidity less than 40%.

5.15 Pre-treatment drying room: with a temperature of 25 ?C ? 2 ?C and a relative humidity less than 5%.

5.16 Desktop digital display thickness gauge: with a resolution of 1 ?m.

5.17 Myriameter.

5.18 Tweezers.

5.19 Insulated tweezers.

6 Test Procedures

6.1 Button-type Half-cell Method

6.1.1 Pre-treatment

6.1.1.1 Lithium nickel manganese oxide (4.1), polyvinylidene fluoride (PVDF) (4.5), conductive agent (4.7): put in the oven (5.1), at 85 ?C ~ 120 ?C, bake for 4 h ~ 20 h. After cooling to room temperature, place it in the desiccator (5.3).

6.1.1.2 Lithium-ion battery separator (4.12): place it in the oven (5.1), at 50 ?C ~ 70 ?C, bake

for 4 h. Take it out and transfer to the inert atmosphere (argon) glove box (5.11).

6.1.1.3 Standard battery structural parts (4.13): use ethanol (4.4) to ultrasonically clean the standard battery structural parts for 1 ~ 3 times, 30 min each time. After the operation is completed, take out the standard battery structural parts and place them in the oven (5.1); at 85

?C, bake for above 12 h, then, transfer to the inert atmosphere (argon) glove box (5.11).

6.1.2 Preparation of positive electrode sheet

6.1.2.1 Test conditions

The operation shall be carried out in the pre-treatment drying room (5.15), and the instruments

and equipment used shall be clean.

6.1.2.2 Weighing

Weigh-take the pre-treated lithium nickel manganese oxide, polyvinylidene fluoride (PVDF) and conductive agent in 6.1.1.1, with a total amount of 4.0 g ~ 25.0 g. The mass fractions of the three are respectively: (90% ~ 96%), (2% ~ 5%) and (2% ~ 5%); use the electronic balance (5.4) for weighing; the amount of N-methylpyrrolidone (NMP) (4.6) is 30% ~ 75% of solid content; use the electronic balance (5.4) for weighing.

NOTE: the solid content is the ratio of the mass of the positive electrode active material lithium nickel manganese oxide, polyvinylidene fluoride (PVDF) and conductive agent to the mass of positive electrode slurry.

6.1.2.3 Slurrying

Add the weighed N-methylpyrrolidone (NMP) and polyvinylidene fluoride (PVDF) into the beaker, place the beaker under the dispersing mixer (5.6), disperse and stir, until the polyvinylidene fluoride (PVDF) is completed dissolved. Thus, prepare it into a colorless and transparent glue solution. Add the weighed conductive agent to the above-mentioned colorless and transparent glue solution, mix and stir it. Slowly add the weighed lithium nickel manganese oxide, evenly disperse and stir it, so that the various materials are evenly mixed.

6.1.2.4 Coating

Use the flat coating machine (5.7) to evenly coat the mixed positive electrode slurry on one side of the aluminum foil (4.9). Put the coated positive electrode sheet into the oven (5.1), at 110 ?C ? 5 ?C, bake it for 2 h ~ 3 h.

6.1.2.5 Production of positive electrode sheet

Take the positive electrode sheet that has been dried and reached the requirements for processability in 6.1.2.4, use the sheet-punching machine (5.9) to punch out the positive electrode sheet with a diameter (D) of 12.0 mm ~ 15.0 mm. Use the electronic balance (5.5) to