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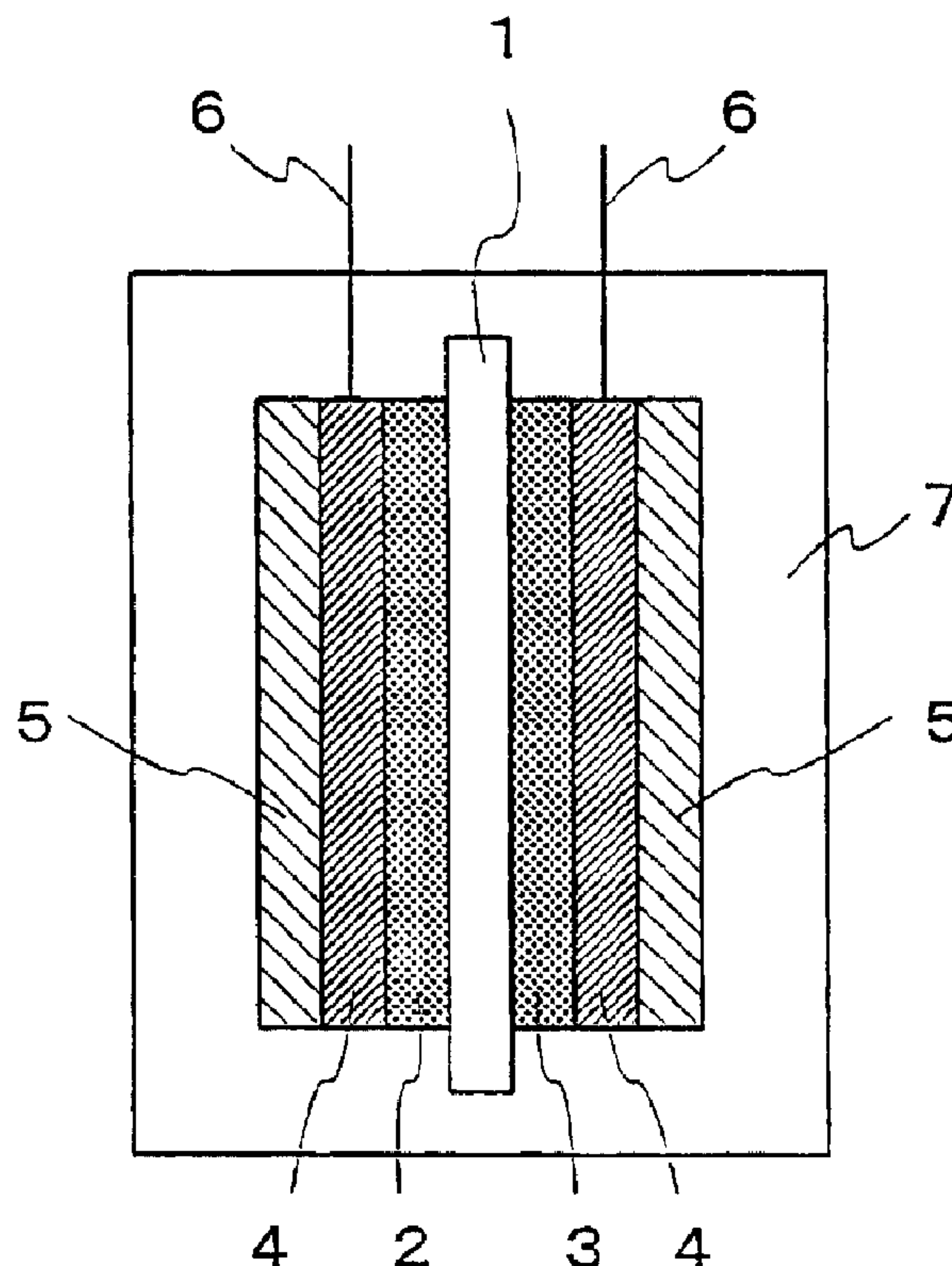
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BATTERIE SECONDAIRE A ELECTROLYTE NON AQUEUX

(54) Title: LITHIUM COBALT COMPOUND OXIDE AND MANUFACTURING METHODS THEREOF, AND NON-
AQUEOUS ELECTROLYTE SECONDARY CELL



(57) Abrégé/Abstract:

A non-aqueous electrolyte secondary cell having improved discharge properties is provided. The non-aqueous electrolyte secondary cell having improved discharge properties can be obtained when a lithium cobalt compound oxide is provided with raw materials of the cobalt oxyhydroxide which has NH₃ content of 0.1 to 5 percent by weight, is used as a positive active materials for a positive electrode.



ABSTRACT OF THE DISCLOSURE

A non-aqueous electrolyte secondary cell having improved discharge properties is provided. The non-aqueous electrolyte secondary cell having improved discharge properties can be obtained when a lithium cobalt compound oxide is provided with raw materials of the cobalt oxyhydroxide which has NH_3 content of 0.1 to 5 percent by weight, is used as a positive active materials for a positive electrode.

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LITHIUM COBALT COMPOUND OXIDE AND MANUFACTURING METHODS
THEREOF, AND NON-AQUEOUS ELECTROLYTE SECONDARY CELL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to lithium cobalt compound oxides and manufacturing methods thereof, non-aqueous electrolyte secondary cells, and portable electronic apparatuses.

2. Description of the Related Art

It has been known that metal ions having an appropriate size can be introduced onto crystal lattice sites and/or between crystal lattice planes of a transition metal oxide having a hexagonal layer crystal structure. In particular, in lithium-containing interlayer compounds, under a specific potential-difference condition, lithium ions can be introduced onto crystal lattice sites and/or between lattice planes and can then be removed therefrom. In addition, since a lithium secondary cell using a lithium cobalt compound oxide, LiCoO_2 , as a positive active material has a high volume energy density, miniaturization and weight reduction of portable electronic apparatuses can be realized, and hence in recent years, the lithium secondary cells have been increasingly in demand as power sources of portable

personal computers and mobile phones.

In addition, research has also been carried out in which inexpensive transition metals, such as nickel or manganese, are used instead of expensive cobalt (for example, refer to Japanese Unexamined Patent Application Publication Nos. 11-71114 and 11-292550). In Japanese Unexamined Patent Application Publication No. 11-292550, a lithium compound oxide has been disclosed which is obtained from a starting material represented by a chemical formula $\text{LiCo}_x\text{Ni}_{(1-x)}\text{O}_2$ ($0.05 \leq x < 1$), and the crystal structure of this lithium compound oxide (LiCoO_2) can be stably maintained even after the Co component thereof is partly replaced with Ni. According to the related techniques as described above, it has been intended to replace expensive cobalt with nickel or the like.

SUMMARY OF THE INVENTION

However, through intensive research carried out by the inventors of the present invention, it was found that when the Co component of the lithium compound oxide (LiCoO_2) functioning as a positive active material is partly replaced with Ni, the discharge properties of a lithium secondary cell is adversely deteriorated. Accordingly, an object of the present invention is to provide a lithium secondary cell having improved discharge properties.

In more particular, the present invention provides the following.

(1) A lithium cobalt compound oxide obtained through reaction of a reaction of a lithium compound and cobalt oxyhydroxide, wherein the cobalt oxyhydroxide is cobalt oxyhydroxide which liberates 0.1 to 5 percent by weight of NH₃ when heated to 500°C.

(2) A method for manufacturing a lithium cobalt compound oxide, is provided which comprises: preparing a mixture of a lithium compound and cobalt oxyhydroxide, wherein the cobalt oxyhydroxide is cobalt oxyhydroxide which liberates 0.1 to 5 percent by weight of NH₃ when heated to 500°C; and heating the mixture.

(3) A non-aqueous electrolyte secondary cell comprising the lithium cobalt compound oxide according to one of Claim 1 as a positive active material used for a positive electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view of a non-aqueous electrolyte secondary cell according to an embodiment of the present invention;

Fig. 2 is a graph showing the relationship between the voltage and the discharge capacity of a non-aqueous electrolyte secondary cell according to the present invention;

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, a positive active material and a non-aqueous electrolyte secondary cell, according to the present invention, will be described in detail.

<Lithium Cobalt Compound Oxide>

A lithium cobalt compound oxide of the present invention is a lithium oxide represented by the chemical formula $\text{Li}_x\text{Co}_{1-y}\text{M}_y\text{O}_2\text{N}_z$.

In the formula described above, M is at least one element selected from the group consisting of transition metal elements except Co and Ni and elements of group II, XIII, XIV, and XV of the periodic table; N represents a halogen atom; and $0.10 \leq x \leq 1.25$, $0 \leq y \leq 0.05$, and $0 \leq z \leq 0.05$ are satisfied. It is more preferable when $0.4 \leq x \leq 1.0$, $0 \leq y \leq 0.01$, and $0 \leq z \leq 0.01$.

are satisfied. The lithium cobalt compound oxide described above can be preferably used as a positive active material for a lithium ion secondary cell using a non-aqueous electrolyte.

In addition to the elements mentioned above, for example, the lithium cobalt compound oxide of the present invention may also contain at least one element selected from the group consisting of B, Mg, Si, Cu, Ce, Y, Ti, V, Mn, Fe, Sn, Zr, Sb, Nb, Ru, Pb, Hf, Ta, La, Pr, and Nd.

In the present invention, a cobalt oxyhydroxide is cobalt oxyhydroxide which liberates 0.1 to 5 percent by weight of NH_3 when heated to 500°C is used.

It is believed that ammonia is liberated at a temperature lower than that at which sintering occurs between a cobalt compound and a lithium compound, for example, at approximately 200°C .

When ammonia is liberated from the mixture of the cobalt compound, minute pores are formed, and the pores may then be clogged by sintering caused by further heating. Hence, as a result, the change in structure of the lithium cobalt compound oxide may occur to a certain extent.

Alternatively, when sintering between the cobalt compound and the lithium compound occurs, a small amount of ammonia may form cores for solid phase reaction, and as a result, crystal grains of the lithium cobalt compound oxide

or the boundaries therebetween may have some structural change to a certain extent.

<Cobalt Oxyhydroxide>

A method for manufacturing the cobalt oxyhydroxide used for the manufacturing method of the present invention is not particularly limited. For example, a material may be used which is formed by oxidizing a compound containing divalent cobalt, such as cobalt nitrate, cobalt chloride, or cobalt sulfate, with an oxidizing agent, followed by neutralization with an alkaline material.

The oxidizing agent mentioned above is not particularly limited, and for example, there may be mentioned air, oxygen, and ozone; permanganic acid (HMnO_4) and salts thereof represented by M^3MnO_4 and the like; chromic acid (CrO_3) and related compounds thereof represented by $\text{M}^3_2\text{Cr}_2\text{O}_7$, M^3_2CrO_4 , $\text{M}^3\text{CrO}_3\text{X}$, CrO_2X_2 , and the like; halogens such as F_2 , Cl_2 , Br_2 , and I_2 ; peroxides such as H_2O_2 , Na_2O_2 , and BaO_2 ; peroxo acids, compounds represented, for example, by $\text{M}^3_2\text{S}_2\text{O}_8$, M^3_2SO_5 , H_2CO_3 , and $\text{CH}_3\text{CO}_3\text{H}$ and salts thereof; and oxygen acids, compounds represented, for example, by M^3MClO , M^3BrO , M^3IO , M^3ClO_3 , M^3BrO_3 , M^3IO_3 , M^3ClO_4 , M^3IO_4 , $\text{Na}_3\text{H}_2\text{IO}_6$, and KIO_4 , and the salts thereof. In the formula, M^3 indicates an alkaline metal element. The alkaline metal element mentioned above is not particularly limited, and for example, lithium, sodium,

potassium, and rubidium may be mentioned. In addition, X indicates a halogen atom.

The alkaline materials used for neutralization are not particularly limited, and an aqueous solution containing an inorganic hydroxide such as lithium hydroxide, sodium hydroxide, potassium hydroxide, magnesium hydroxide, calcium hydroxide, barium hydroxide, or ammonium hydroxide may be preferably used.

The cobalt oxyhydroxide described above can be obtained by the steps of dissolving a compound containing divalent cobalt such as cobalt nitrate, cobalt chloride, or cobalt sulfate in water for forming an aqueous solution, and subsequently adding the oxidizing agent and the alkaline material described above for simultaneously performing the neutralization and oxidation. Alternatively, the cobalt oxyhydroxide can also be obtained by synthesizing divalent cobalt hydroxide by adding the alkaline material to an aqueous solution containing the above divalent cobalt compound, followed by oxidation with an oxidizing agent. Furthermore, the cobalt oxyhydroxide may also be obtained by neutralization by addition of the alkaline material after the oxidizing agent is added to an aqueous solution containing the above divalent cobalt compound.

It is believed that the cobalt oxyhydroxide is primarily composed of CoOOH ; however, Co_3O_4 , CoCO_3 , and the

like may also be contained.

<Lithium Compound>

The manufacturing method of the present invention uses a lithium compound. The lithium compound is not particularly limited; however, for example, an inorganic lithium salt, such as lithium hydroxide, lithium carbonate, or lithium nitrate may be preferably used. As the lithium compound, lithium carbonate is preferable since being easily available and inexpensive. A lithium compound having a higher purity is preferably used.

<Manufacturing Method>

According to the manufacturing method of the present invention, for example, a mixture is first obtained by mixing the cobalt oxyhydroxide with a lithium compound, preferably with lithium carbonate. A wet or a dry mixing method may be optionally performed; however, a dry mixing method is preferable since being easily performed. In the dry mixing method, a blender is preferably used for uniformly mixing starting materials. The mixing ratio of the lithium compound to the cobalt compound, which compounds are starting materials in the mixing step, on an atomic basis (Li/Co) is set to 0.99 to 1.06 and is preferably set to 0.99 to 1.02.

Next, the mixture thus prepared is fired. The firing temperature is preferably 700 to 1,110°C and more preferably 850 to 1,050°C. The firing time is 1 to 24 hours and preferably 2 to 10 hours. When the firing temperature is decreased below 700°C, the lithium cobalt compound oxide cannot be sufficiently synthesized, and as a result, the cobalt oxyhydroxide and the lithium compound used as the starting materials unfavorably remain. On the other hand, when the firing temperature is increased above 1,100°C, the decomposition of the desired lithium cobalt compound oxide will start, and when this lithium cobalt compound oxide is used as a positive active material, the degradation in cell properties may occur, that is, in particular, the decrease in capacity at a voltage at the stage of the end of discharge and the degradation in cyclic properties unfavorably occur.

The firing may be performed either in the air or in an oxygen atmosphere and is not particularly limited. After the firing, cooling is optionally performed, followed by pulverization whenever necessary, thereby forming the lithium cobalt compound oxide. The pulverization performed whenever necessary is optionally performed, for example, when particles of the lithium cobalt compound oxide obtained by firing are loosely bonded to each other in the form of a block.

<Measurement Method of NH₃ Content>

A sample in an amount of 2 g was heated to 500°C for 30 minutes in an inert gas (Ar), and a generated gas was collected. Subsequently, the gas thus collected was measured using a NH₃ gas detector (manufactured by Gastec Corporation) for the NH₃ amount determination.

<Formation Method of Cell>

As the positive active material for a lithium secondary cell, the lithium cobalt compound oxide described above is used. The positive active material is one of stating materials for a positive electrode compound of a lithium secondary cell, the positive electrode compound, which will be described later, being a mixture formed of the positive active material, a conductive agent, a binder, filler whenever necessary, and the like. Since the positive active material of the lithium secondary cell, according to the present invention, is formed of the lithium cobalt compound oxide described above, kneading with the other starting materials can be easily performed when the positive electrode compound is prepared, and in addition, coating of a positive electrode collector with the positive electrode compound thus obtained can also be easily performed.

The lithium secondary cell of the present invention

uses the lithium cobalt compound oxide as a positive active material and comprises a positive electrode, a negative electrode, separators, and a non-aqueous electrolyte containing a lithium salt. The positive electrode is formed, for example, by applying a positive electrode compound onto a positive electrode collector, followed by drying, and the positive electrode compound is composed of a positive active material, a conductive agent, a binder, and filler whenever necessary, and the like.

A material for the positive electrode collector is not particularly limited as long as being inactive in an assembled cell in view of chemical reaction, and for example, there may be mentioned stainless steel, nickel, aluminum, titanium, baked carbon, and aluminum or stainless steel surface-treated with carbon, nickel, titanium, or silver.

As the conductive agent, for example, there may be mentioned conductive materials, such as graphite including natural graphite and manmade graphite, carbon black, acetylene black, carbon fiber, carbon nanotube, and metal such as powdered nickel. As the natural graphite, for example, scaly graphite, flake graphite, and earthy graphite may be mentioned. Those mentioned above may be used alone or in combination. The content of the conductive agent in the positive electrode compound is 1 to 50 percent by weight and preferably 2 to 30 percent by weight.

As the binder, for example, there may be mentioned polysaccharides, thermoplastic resins, and polymers having elasticity, such as poly(vinylidene fluoride), poly(vinyl chloride), carboxymethylcellulose, hydroxylpropylcellulose, recycled cellulose, diacetylcellulose, poly(vinyl pyrrolidone), ethylene-propylene-diene-terpolymer (EPDM), sulfonated EPDM, styrene-butadiene rubber, fluorinated rubber, and polyethylene oxide. Those mentioned above may be used alone or in combination. The content of the binder in the positive electrode compound is 2 to 30 percent by weight and preferably 5 to 15 percent by weight.

The filler of the positive electrode compound has a function of suppressing the volume expansion or the like of the positive electrode and is used whenever necessary. As the filler, any fiber materials may be used as long as being in active in an assembled cell in view of chemical reaction, and for example, fibers made of olefinic polymers such as polypropylene and polyethylene, glass fibers, and carbon fibers may be used. The content of the filler is not particularly limited and is preferably 0 to 30 percent by weight of the positive electrode compound.

The negative electrode is formed by applying a negative electrode material onto a negative electrode collector, followed by drying. As the negative electrode collector, any material may be used as long as being in active in an

assembled cell in view of chemical reaction, and for example, there may be mentioned stainless steel, nickel, copper, titanium, aluminum, baked carbon, copper or stainless steel surface-treated with carbon, nickel, titanium, or silver, and aluminum-cadmium alloy.

The negative electrode material is not particularly limited, and for example, there may be mentioned carbonaceous materials, metal composite oxides, metal lithium, and lithium alloys. As the carbonaceous material, for example, hard-graphitized carbon materials and graphite-base carbon materials may be mentioned. As the metal composite oxide, for example, there may be mentioned a compound represented by $\text{Sn}_p\text{M}^1\text{-pM}^2\text{O}_r$ (where, M^1 is at least one element selected from the group consisting of Mn, Fe, Pb, and Ge; M^2 is at least one element selected from the group consisting of Al, B, P, Si, elements of group I, II, and III of the periodic table, and halogen atoms; and $0 < p \leq 1$, $1 \leq q \leq 3$, and $1 \leq r \leq 8$ are satisfied).

As the separator, an insulating thin film having a high ion transmittance and a predetermined mechanical strength is used. Sheets and nonwoven cloths may be used which are made of glass fibers or an olefinic polymer, such as polyethylene or polypropylene, having organic-solvent resistance and hydrophobic properties. The pore diameter of the separator is not particularly limited as long as effectively used for

a general cell application and is, for example, 0.01 to 10 μm . The thickness of the separator may be in the range used for a general cell application and is, for example, 5 to 300 μm . In addition, in the case in which a solid electrolyte such as a polymer is used as described later, the solid electrolyte may also be used as the separator. In addition, in order to improve the discharge properties and the charge and discharge properties, a compound such as pyridine, triethyl phosphite, or triethanolamine may be added to the electrolyte.

The non-aqueous electrolyte containing a lithium salt is a mixture of a non-aqueous electrolyte and a lithium salt. As the non-aqueous electrolyte, a non-aqueous electrolyte or an organic solid electrolyte is used. As the non-aqueous electrolyte, for example, there may be mentioned aprotic organic solvents such as N-methyl-2-pyrrolidinone, propylene carbonate, ethylene carbonate, butylene carbonate, dimethyl carbonate, diethyl carbonate, γ -butyrolactone, 1,2-dimethoxyethane, tetrahydrofuran, 2-methyl tetrahydrofuran, dimethyl sulfoxide, 1,3-dioxolane, formamide, dimethyl formamide, dioxolane, acetonitrile, nitromethane, methyl formate, methyl acetate, a phosphoric acid triester, trimethoxymethane, a dioxolane derivative, sulfolane, 3-methyl-2-oxazolidinone, a propylene carbonate derivative, a tetrahydrofuran derivative, diethyl ether, and 1,3-

propanesultone. Those mentioned above may be used alone or in combination.

As the organic solid electrolyte, for example, a polyethylene derivative, a polymer including the same, a propylene oxide derivative, a polymer including the same, and a phosphate polymer may be mentioned. As the lithium salt, a material dissolved in the non-aqueous electrolyte described above is used, and for example, LiClO_4 , LiBF_4 , LiPF_6 , LiCF_3SO_3 , LiCF_3CO_2 , LiAsF_6 , LiSbF_6 , $\text{LiB}_{10}\text{Cl}_{10}$, LiAlCl_4 , chloroboran lithium, a lithium lower aliphatic carboxylate, and lithium tetraphenylborate may be used alone or in combination.

The shape of the lithium secondary cell of the present invention may be a button, sheet, cylinder, rectangle, or the like. The application of the secondary cell of the present invention is not particularly limited and may be applied to electronic apparatuses, such as notebook personal computers, laptop personal computers, pocket type word processors, mobile phones, cordless phone handsets, portable CD players, and radios, and consumer electronic apparatuses for automobiles, electric vehicles, and game machines. In addition, the lithium secondary cell is categorized in a non-aqueous electrolyte secondary cell.

<Portable Electronic Apparatuses>

The present invention provides a portable electronic apparatuses incorporating the non-aqueous electrolyte secondary cell described above. As the portable electronic apparatuses, for example, notebook personal computers, pocket type word processors, mobile phones, cordless phone handsets, portable CD players, radios, and game machines may be mentioned.

EXAMPLES

Hereinafter, the lithium cobalt compound oxide and the non-aqueous electrolyte secondary cell, according to the present invention, will be further described in detail.

(Lithium Cobalt Compound Oxide)

Example 1

Lithium carbonate (average particle diameter of 11.0 μm) and cobalt oxyhydroxide containing NH_3 at a content of 5.0 percent by weight were prepared so that the ratio Li/Co on an atomic basis was 0.99 to 1.060 and were then sufficiently mixed in a mortar, thereby forming a uniform mixture. Subsequently, the mixture thus formed was placed in an alumina crucible and was then heated to 900°C for 10 hours in an air atmosphere using an electric furnace, thereby forming a lithium cobalt compound oxide (LiCoO_2). The average particle diameter was 10.7 μm .

Example 2

Lithium carbonate (average particle diameter of 11.0 μm) and cobalt oxyhydroxide containing NH_3 at a content of 1.0 percent by weight were prepared so that the ratio Li/Co on an atomic basis was 0.99 to 1.060 and were then sufficiently mixed in a mortar, thereby forming a uniform mixture. Subsequently, the mixture thus formed was placed in an alumina crucible and was then heated to 1,020°C for 10 hours in an air atmosphere using an electric furnace, thereby forming a lithium cobalt compound oxide (LiCoO_2). The average particle diameter was 12.1 μm .

Example 3

Lithium carbonate (average particle diameter of 11.0 μm) and cobalt oxyhydroxide containing NH_3 at a content of 0.1 percent by weight were prepared so that the ratio Li/Co on an atomic basis was 0.99 to 1.060 and were then sufficiently mixed in a mortar, thereby forming a uniform mixture. Subsequently, the mixture thus formed was placed in an alumina crucible and was then heated to 850°C for 10 hours in an air atmosphere using an electric furnace, thereby forming a lithium cobalt compound oxide (LiCoO_2). The average particle diameter was 13.5 μm .

Comparative Example 1

Lithium carbonate (average particle diameter of 11.0 μm) and cobalt oxyhydroxide containing NH_3 at a content of 0.05 percent by weight were prepared so that the ratio Li/Co on an atomic basis was 0.99 to 1.060 and were then sufficiently mixed in a mortar, thereby forming a uniform mixture. Subsequently, the mixture thus formed was placed in an alumina crucible and was then heated to 1,020°C for 10 hours in an air atmosphere using an electric furnace, thereby forming a lithium cobalt compound oxide (LiCoO_2). The average particle diameter was 13.5 μm .

Comparative Example 2

Lithium carbonate (average particle diameter of 11.0 μm) and cobalt oxyhydroxide containing NH_3 at a content of 0.01 percent by weight were prepared so that the ratio Li/Co on an atomic basis was 0.99 to 1.060 and were then sufficiently mixed in a mortar, thereby forming a uniform mixture. Subsequently, the mixture thus formed was placed in an alumina crucible and was then heated to 920°C for 10 hours in an air atmosphere using an electric furnace, thereby forming a lithium cobalt compound oxide (LiCoO_2). The average particle diameter was 11.9 μm .

Comparative Example 3

Lithium carbonate (average particle diameter of 11.0 μm) and cobalt oxyhydroxide containing NH_3 at a content of 6.0 percent by weight were prepared so that the ratio Li/Co on an atomic basis was 0.99 to 1.060 and were then sufficiently mixed in a mortar, thereby forming a uniform mixture. Subsequently, the mixture thus formed was placed in an alumina crucible and was then heated to 980°C for 10 hours in an air atmosphere using an electric furnace, thereby forming a lithium cobalt compound oxide (LiCoO_2). The average particle diameter was 11.8 μm .

<Cell Performance Test>

(I) Formation of Lithium Secondary Cell

A positive electrode material was formed by mixing 91 percent by weight of each of the lithium cobalt compound oxides formed in accordance with Examples 1 to 3 and Comparative Examples 1 to 3, 6 percent by weight of powdered graphite, and 3 percent by weight of poly(vinylidene fluoride), and the positive electrode material thus obtained was dispersed in N-methyl-2-pyrrolidinone, thereby forming a paste compound. After this paste compound was applied onto an aluminum foil and then dried, a disc 15 mm in diameter was punched out therefrom, and hence a positive electrode plate was obtained.

As shown in Fig. 1, a lithium secondary cell, that is, a non-aqueous electrolyte secondary cell, was formed by using a separator 1, a negative electrode 2, a positive electrode 3, collectors 4, mounting tags 5, exterior terminals 6, an electrolyte 7, and the like. Among the members mentioned above, a lithium metal foil was used as the negative electrode, and the electrolyte was formed by dissolving one mole of LiPF_6 in one liter of a mixed solution of ethylene carbonate and diethyl carbonate at a ratio of 1 to 1.

(II) Evaluation of Cell Performance

The lithium secondary cell thus formed was operated at room temperature, and the initial discharge capacity was measured for evaluation of the cell performance.

(III) Evaluation Method

The discharge capacity was measured by the steps of charging a cell in a CCCV (constant-current, constant-voltage, 1.0C) mode up to 4.3 V with respect to the positive electrode and then discharging it down to 2.7 V. Lithium secondary cells formed from the lithium cobalt compound oxides as a positive active material, which were obtained in Examples 1 to 3 and Comparative Examples 1 to 3, were evaluated as described above, and the relationship between

the voltage and the discharge capacity is shown in Fig. 2.

Experimental Result

A constant-current charge test was performed at a potential 2.7 to 4.3 V (vs. Li/Li⁺) using an electrode coated with the active material obtained in each of Examples 1 to 3 and Comparative Examples 1 to 3. The discharge curves are shown in Fig. 2. The test was performed at a charge and discharge current of 0.2C.

From the results thus obtained, it was found that the active materials formed in Examples 1 to 3 have a large discharge capacity as compared to that obtained in Comparative Examples 1 to 3.

The reason for this is believed that since NH₃ contained in the cobalt oxyhydroxide is liberated from the mixture of the cobalt oxyhydroxide and lithium compound, nute pore are formed. Hence, as a result, quick-charge/discharge-capability ability has good properties, because of Li disffusion pass may occur at charge and discharge of battery.

WHAT IS CLAIMED IS:

1. A lithium cobalt compound oxide obtained through reaction of a reaction of a lithium compound and cobalt oxyhydroxide, wherein the cobalt oxyhydroxide is cobalt oxyhydroxide which liberates 0.1 to 5 percent by weight of NH₃ when heated to 500°C.
2. A method for manufacturing a lithium cobalt compound oxide, is provided which comprises: preparing a mixture of a lithium compound and cobalt oxyhydroxide, wherein the cobalt oxyhydroxide is cobalt oxyhydroxide which liberates 0.1 to 5 percent by weight of NH₃ when heated to 500°C; and heating the mixture.
3. A non-aqueous electrolyte secondary cell comprising the lithium cobalt compound oxide according to one of Claim 1 as a positive active material used for a positive electrode.

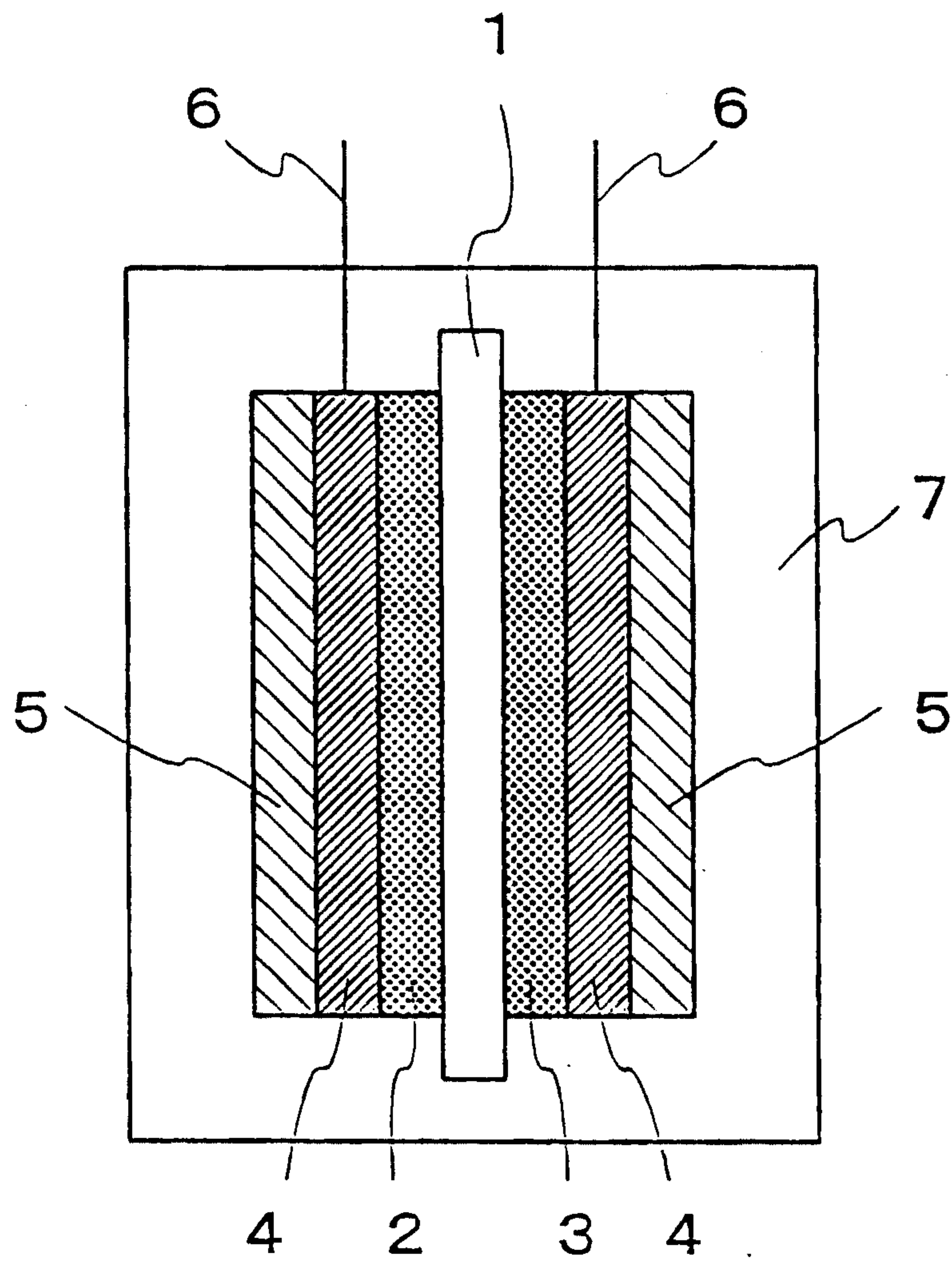


Fig. 1

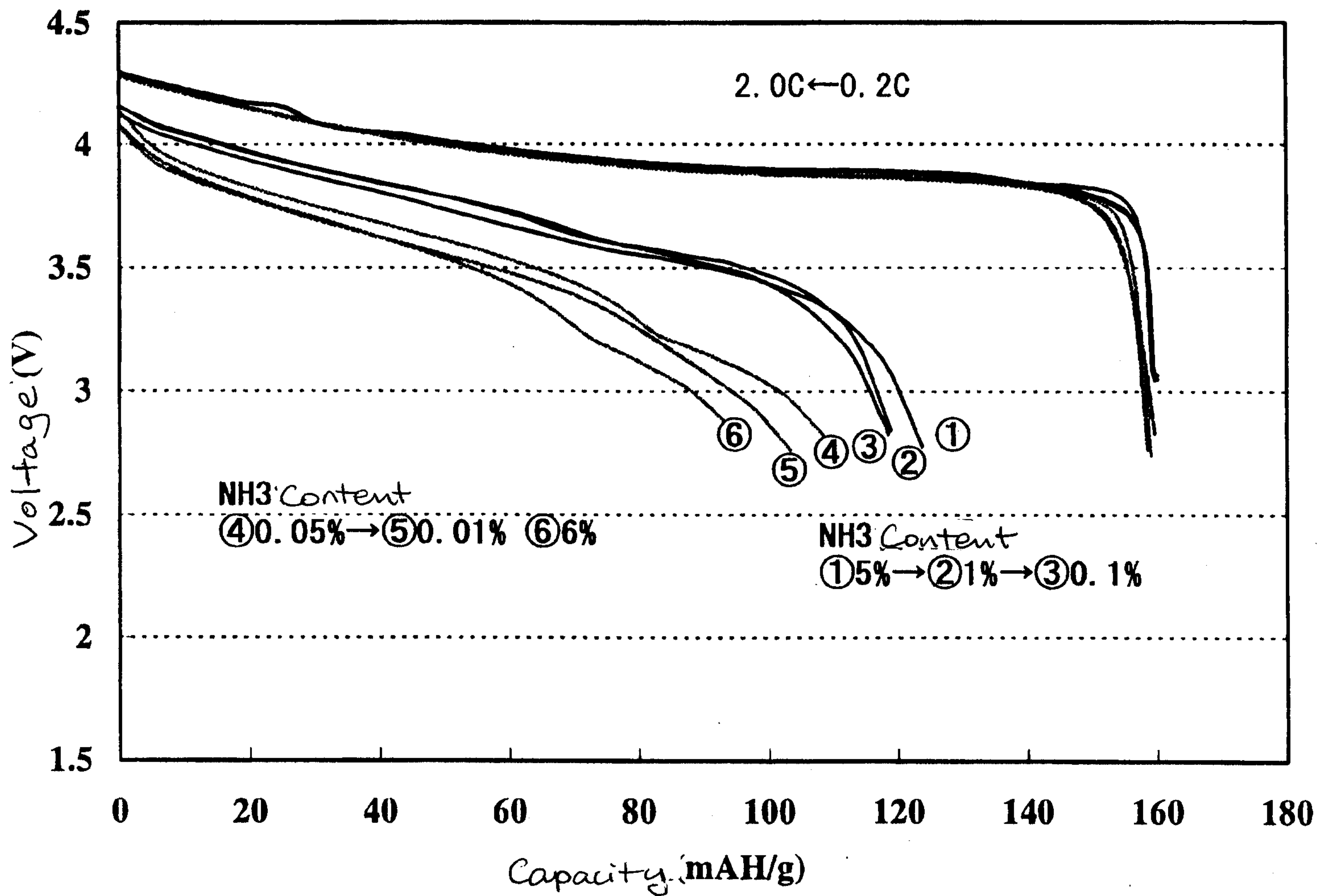


Fig. 2

