

Appeal decision

Appeal No. 2015-9713

Korea

Appellant

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The case of appeal against the examiner's decision of refusal of Japanese Patent Application No. 2013-548373, entitled "Electrode assembly for secondary battery and lithium secondary battery including the same" [international publication on Jan. 3, 2013: WO 2013/002608, national publication of the translated version on Feb. 27, 2014: National Publication of International Patent Application No. 2014-505335] has resulted in the following appeal decision:

Conclusion

The appeal of the case was groundless.

Reason

No. 1 History of the procedures

The present application is based on an International Patent Application filed on Jun. 29, 2012 (claim of priority under the Paris Convention on Jun. 30, 2011, Republic of Korea). A written opinion and a written amendment were submitted on Oct. 30, 2014 in response to a notification of reasons for refusal dated Jul. 28, 2014. A decision of refusal dated Jan. 19, 2015 was made by an examiner.

The appeal against the examiner's decision of refusal was requested on May 26, 2015, and a written amendment was submitted at the same time.

No. 2 Decision to dismiss the amendment as to the amendment dated May 26, 2015

[Conclusion of Decision to dismiss Amendment]

The amendment dated May 26, 2015 (hereinafter, referred to as "the Amendment of the case") shall be dismissed.

[Reasons]

1 Details of Amendment

The Amendment intends to modify the scope of claims as follows:

Before the Amendment:

"[Claim 1]

An electrode assembly for a secondary battery, comprising:

a positive electrode having a positive electrode active material layer formed on a positive electrode collector;

a negative electrode having a negative electrode active material layer formed on a negative electrode collector; and

a polyolefin-based separation film interposed between the positive electrode and the negative electrode,

wherein a PTC (Positive Temperature Coefficient) material layer is formed on a

top face of an active material layer of at least any one of the positive electrode and the negative electrode, and the PTC material layer has a same area as that of each active material layer.

[Claim 2]

The electrode assembly for a secondary battery according to claim 1, wherein the PTC material layer has an effective operating temperature ranging from 80 degrees C to 140 degrees C.

[Claim 3]

The electrode assembly for a secondary battery according to claim 1 or 2, wherein the PTC material layer has a thickness of 1 to 30 μm .

[Claim 4]

The electrode assembly for a secondary battery according to any one of claims 1-3, wherein the PTC material layer includes carbon black, carbon fiber, or a mixture thereof.

[Claim 5]

The electrode assembly for a secondary battery according to any one of claims 1-4,

wherein the electrode assembly is any one selected from the group consisting of: a stack and folding type electrode assembly manufactured by folding a bi-cell and a full-cell in a state that the bi-cell and the full-cell intersect on a continuously longitudinally cut separation film; a stack and folding type electrode assembly manufactured by folding a bi-cell in a state that only the bi-cell is laid on a separation film; a stack and folding type electrode assembly manufactured by folding a full-cell in a state that only the full-cell is laid on the separation film; a Z type stack and folding electrode assembly manufactured by folding a bi-cell or a full-cell onto a separation film in a zigzag direction; a stack and folding type electrode assembly manufactured by continuously folding a bi-cell or a full-cell in the same direction; an electrode assembly manufactured by folding positive and negative electrodes in a state that the positive electrode and the negative electrode intersect on a longitudinally cut separation film; a jelly-roll type electrode assembly manufactured by winding a positive electrode plate, a separator, and a negative electrode plate in a direction in a state that the positive electrode plate, the separator, and the negative electrode plate are sequentially arranged; and a stack type electrode assembly.

[Claim 6]

A lithium secondary battery comprising an electrode assembly for a secondary battery according to any one of claims 1-5.

[Claim 7]

A battery pack comprising the lithium secondary battery according to claim 6.

[Claim 8]

The battery pack according to claim 7, wherein the battery pack is used as a power supply of a middle- or large-sized device.

[Claim 9]

The battery pack according to claim 8, wherein the middle- or large-sized device is any one selected from the group consisting of: a power tool; electric cars including an Electric Vehicle (EV), a Hybrid Electric Vehicle (HEV), and a Plug-in Hybrid Electric Vehicle (PHEV); electric two-wheeled vehicles including an E-bike and an E-scooter; an electric golf cart; an electric truck; an electric commercial vehicle; and

an electric power storage system."

After the amendment:

"[Claim 1]

An electrode assembly for a secondary battery, comprising:

a positive electrode having a positive electrode active material layer formed on a positive electrode collector;

a negative electrode having a negative electrode active material layer formed on a negative electrode collector; and

a polyolefin-based separation film interposed between the positive electrode and the negative electrode,

wherein a PTC (Positive Temperature Coefficient) material layer is formed on a top face of an active material layer of at least either one of the positive electrode and the negative electrode, the PTC material layer having the same area as that of each active material layer, and

wherein the PTC material layer includes high-density polyethylene of 40 to 60 weight% of the total weight of a PTC composition, the high-density polyethylene having a density exceeding 0.94 g/cm³.

[Claim 2]

The electrode assembly for a secondary battery according to claim 1, wherein the PTC material layer has an effective operating temperature ranging from 80 degrees C to 140 degrees C.

[Claim 3]

The electrode assembly for a secondary battery according to claim 1 or 2, wherein the PTC material layer has a thickness of 1 to 30 μm.

[Claim 4]

The electrode assembly for a secondary battery according to any one of claims 1-3, wherein the PTC material layer includes carbon black, carbon fiber, or a mixture thereof.

[Claim 5]

The electrode assembly for a secondary battery according to any one of claims 1 -4,

wherein the electrode assembly is any one selected from the group consisting of:

a stack and folding type electrode assembly manufactured by folding a bi-cell and a full-cell in a state that the bi-cell and the full-cell intersect on a continuously longitudinally cut separation film;

a stack and folding type electrode assembly manufactured by folding a bi-cell in a state that only the bi-cell is laid on a separation film;

a stack and folding type electrode assembly manufactured by folding a full-cell in a state that only the full-cell is laid on the separation film;

a Z type stack and folding electrode assembly manufactured by folding a bi-cell or a full-cell onto a separation film in a zigzag direction;

a stack and folding type electrode assembly manufactured by continuously folding a bi-cell or a full-cell in the same direction;

an electrode assembly manufactured by folding positive and negative electrodes in a state that the positive electrode and the negative electrode intersect on a longitudinally cut separation film;

a jelly-roll type electrode assembly manufactured by winding a positive electrode plate, a separator, and a negative electrode plate in a direction in a state that the positive electrode plate, the separator, and the negative electrode plate are sequentially arranged; and

a stack type electrode assembly.

[Claim 6]

A lithium secondary battery comprising an electrode assembly for a secondary battery according to any one of claims 1-5.

[Claim 7]

A battery pack comprising the lithium secondary battery according to claim 6.

[Claim 8]

The battery pack according to claim 7, wherein the battery pack is used as a power supply of a middle- or large-sized device.

[Claim 9]

The battery pack according to claim 8, wherein the middle- or large-sized device is any one selected from the group consisting of:

a power tool; electric cars including an Electric Vehicle (EV), a Hybrid Electric Vehicle (HEV), and a Plug-in Hybrid Electric Vehicle (PHEV);

electric two-wheeled vehicles including an E-bike and an E-scooter;

an electric golf cart;

an electric truck;

an electric commercial vehicle; and

an electric power storage system."

2 Examination regarding legitimacy on the purpose of the amendment and emerging new matters in the amendment.

The Amendment relates to a "PTC material layer" specified in the invention according to claim 1 before the Amendment. It intends to specify the structure "including high-density polyethylene of 40 to 60 weight% of the total weight of a PTC composition, the high-density polyethylene having a density exceeding 0.94 g/cm³" on the basis of the descriptions "'high density' means to have a density exceeding 0.94 g/cm³" ([0030]) and "the amount of thermoplastic polymer can be 40 to 60 weight% ...(abbreviated)... of the total weight of the PTC composition" ([0031]).

Since the amendment relates to a "PTC material layer" in claim 1 before the Amendment and intend to specify it concretely on the basis of the description, it is obvious that the purpose of the amendment is to restrict the scope of claims. Also, the inventions according to claim 1 before and after the Amendment belong to the same industrial field and aim to solve the same problems.

Accordingly, the Amendment satisfies the requirement of Article 17-2(3) of the same Act since it meets the requirement regarding the purpose of amendment as to restriction of the scope of claims prescribed in Article 17-2(5)(ii) of the Patent Act and it does not include a new matter.

It will be examined whether or not the invention according to claim 6 that refers to claim 1 after the Amendment complies with the provisions of Article 126(7) of the Patent Act as applied mutatis mutandis pursuant to the provisions of Article 17-2(6) of the same Act; that is, it will be examined whether or not the appellant should be

granted a patent independently at the time of filing of the patent application.

3 The Amended Invention

The invention according to claim 6 that refers to claim 1 after the Amendment (hereinafter, referred to as "Amended Invention") is rewritten as follows by dissolving the citation relation.

"A lithium secondary battery comprising an electrode assembly for a secondary battery, the electrode assembly comprising:

a positive electrode having a positive electrode active material layer formed on a positive electrode collector;

a negative electrode having a negative electrode active material layer formed on a negative electrode collector; and

a polyolefin-based separation film interposed between the positive electrode and the negative electrode,

wherein a PTC (Positive Temperature Coefficient) material layer is formed on a top face of an active material layer of at least any one of the positive electrode and the negative electrode, and the PTC material layer has the same area as that of each active material layer, and

wherein the PTC material layer includes high-density polyethylene of 40 to 60 weight% of the total weight of a PTC composition, the high-density polyethylene having a density exceeding 0.94 g/cm³."

4 Cited publications

(1) Cited publication 1

In "Japanese Unexamined Patent Application Publication No. 2006-179432" (hereinafter, referred to as "Cited Document 1"), which was cited in the reasons for refusal of the examiner's decision and distributed on Jul. 6, 2006 before the priority date of the present application, the followings are described. The under lines are added by the body.

A Statements of the scope of claims

"[Claim 1]

A nonaqueous electrolyte secondary battery comprising: a positive electrode; a negative electrode; a separator arranged between the positive electrode and the negative electrode; and a nonaqueous electrolyte,

wherein a porous layer is arranged on a surface of a separator side of at least one electrode selected from the positive electrode and the negative electrode, and

wherein the porous layer includes an electron-conductive material having a Curie temperature of 40 degrees C or more to 200 degrees C or less."

"[Claim 9]

The nonaqueous electrolyte secondary battery according to claim 1, wherein the separator comprises polyolefin."

B The statements of the detailed explanation of the invention

"[Technical Field]

[0001]

The present invention relates to a high-security nonaqueous electrolyte secondary battery."

"[Description of Embodiments]

[0010]

An example of a nonaqueous electrolyte secondary battery of the present invention is a nonaqueous electrolyte lithium secondary battery that includes a positive electrode, a negative electrode, a separator arranged between the positive electrode and the negative electrode, and a nonaqueous electrolyte, wherein a porous layer is arranged on a surface of a separator side of at least one electrode selected from the positive electrode and the negative electrode, and wherein the porous layer includes an electron-conductive material having a Curie temperature of 40 degrees C or more to 200 degrees C or less.

[0011]

The above-mentioned electron-conductive material has characteristics that, when Curie temperature is reached, electric resistance increases drastically due to its positive temperature characteristic coefficient. Hereinafter, such characteristics are called PTC (Positive Temperature Coefficient) characteristics. That is, Curie temperature is a temperature at which, when that temperature is reached, electric resistance of a substance increases drastically.

[0012]

By this, even if a battery temperature rises by heat generation due to an internal short circuit or the like, when the temperature of a porous layer reaches the above-mentioned Curie temperature, the electric resistance of an electron-conductive material included in the porous layer rises, and increase of short circuit current can be suppressed. In addition, security of a battery can be further enhanced because, even if the electric resistance of a porous layer rises by rise of battery temperature due to a short circuit, a small short circuit current flows to enable gradual release of internal energy of the battery.

[0013]

The Curie temperature of the above-mentioned electron-conductive material needs to be 40 degrees C or more to 200 degrees C or less, and, more preferably, is 50 degrees C or more to 150 degrees C or less, and, further preferably, is 60 degrees C or more to 120 degrees C or less, and, most preferably, is 70 degrees C or more to 100 degrees C or less. The reason for this is that, if it is within this range, security of a battery can be secured without affecting battery performance such as load characteristics.

[0014]

In addition, when a separator having a shutdown function is used, it is preferred that the Curie temperature of the above-mentioned electron-conductive material be lower than the melting temperature (shutdown temperature) of the separator by 10 degrees C or more, and, more preferably, by 20 degrees C or more. The reason for this is that, by this, increase of short circuit current can be suppressed more effectively by using the PTC characteristic of a porous layer and the shutdown function of a separator together, and security of a battery can be secured certainly.

[0015]

No particular limitation is imposed on the above-mentioned electron-conductive material so long as it is a material that has the above-mentioned Curie temperature, is chemically and electrochemically stabilized within a battery, and is not eluted to nonaqueous electrolyte, and is at least one kind of a material selected

from: an inorganic material to which electron conductivity is given; a high-polymer material to which electron conductivity is given; and a complex material of these inorganic material and high-polymer material.

[0016]

As the above-mentioned inorganic material, BaTiO₃ to which a slight amount of rare-earth element (for example, Y₂O₃, La and the like) is added is used suitably. This is because BaTiO₃ to which a slight amount of rare-earth element is added has electron conductivity, and, by adjusting an amount of rare-earth element to be added, Curie temperature can be adjusted arbitrarily.

[0017]

As the above-mentioned high-polymer material, a high-polymer compound to which a conductivity imparting agent is added is suitably used. This is because this high-polymer material has electron conductivity, and Curie temperature can be adjusted arbitrarily by adjusting molecular weight of the high-polymer compound or by introduction of an additive agent. As an additive agent, heavy oil, paraffin, wax, and the like can be used, for example.

[0018]

The above-mentioned high-polymer compound preferably is a crystalline high-polymer compound, and, more preferably, is one that has a crystallinity degree of 10% or more, and a melting point of around 40-200 degrees C. This is because adjustment of Curie temperature is easy. Specifically, there are used polymer or oligomer represented by polyolefin such as high-density polyethylene, medium density polyethylene, low density polyethylene, polypropylene, polymethylene, ethylene-propylene copolymer, and polybutadiene, or a resin system high-polymer compound such as polyethylene terephthalate, aromatic polyamide, or cellulose; a rubber-like high-polymer compound such as styrene-butadiene rubber, isoprene rubber, butadiene rubber, or ethylene-propylene rubber; a thermal plasticity elastomer-like high-polymer compound such as a styrene-butadiene-styrene block copolymer and its hydrogen additive agent, a styrene-ethylene-butadiene-styrene block copolymer and its hydrogen-added agent, or a styrene-isoprene-styrene block copolymer and its hydrogen-added agent; a soft resin-like high-polymer compound such as syndiotactic 1,2-polybutadiene, an ethylene vinyl acetate copolymer, or a propylene-alpha-olefin (carbon number 2-12) copolymer; a fluorine system high-polymer compound such as polyvinylidene fluoride, polytetrafluoroethylene, or a polytetrafluoroethylene-ethylene copolymer; and various kinds of wax, asphalt, and the like. In addition, polyamide resin, polyethylene oxide, polypropylene oxide, particulate phenol resin, and the like can be used. Among these, polymers of low molecular weight represented by polyethylene wax of low molecular weight, low density polyethylene, and wax having a melting point of 50-100 degrees C are more desirable in particular because they are superior in material cost and productivity. Regarding these high-polymer compounds, it may be the case that only one kind is selected and used, or two kinds or more of them may be used in a combined manner in order to obtain necessary positive temperature characteristics. In addition, an additive agent such as heavy oil or paraffin may be added in order to lower the melting point of a high-polymer compound. In this regard, however, these additive agents are required not to elute into an electrolyte solution and are required to be stable electrochemically and chemically.

[0019]

In addition, as a high-polymer compound mentioned above, an amorphous high-polymer compound having a crystallinity degree of less than 10% can also be used. As such amorphous high-polymer compound, ones that are solvent-soluble at room temperature are preferable from the handling point of view, and, specifically, natural rubber, synthesis rubber such as isoprene rubber, nitrile rubber, or ethylene-propylene-diene monomer copolymer, alkyl acrylate polymer, or the like is used.

[0020]

No particular limitation is imposed on a synthesis and processing method and the like of the above-mentioned high-polymer compound. When a crystalline high-polymer compound having weak adhesion properties is used, although, generally, it is possible to introduce a functional group or to make it contain an organic product (a coupling agent, a dispersing agent, or the like) having compatibility with both of an electrode that is an adherend and a crystalline high-polymer compound, introduction of a functional group is preferred if various characteristics are taken into consideration. In addition, to this high-polymer compound, a cross-linking agent, a cross-linking promoter, a processing aid, an antioxidizing agent, an ultraviolet light absorption agent, and the like can be combined further.

[0021]

As a conductivity imparting agent that is added to the above-mentioned high-polymer compound, a carbon material, conductive non-oxide, and a metal fine particle or the like are used, for example."

"[0025]

Although no particular limitation is imposed on an added quantity of a conductivity imparting agent to be added to the above-mentioned high-polymer compound, it can be made to be 10-90 mass% relative to the total mass of the high-polymer material, preferably 30-80 mass%, and further preferably 40-70 mass%. The reason for this is that, if it is within this range, electric resistance of a high-polymer material as a whole can be lowered while maintaining the PTC characteristic of the high-polymer compound well."

"[0039]

It is preferred that, as a positive electrode active material used for the above-mentioned positive electrode, a compound capable of occluding and releasing lithium be used. By this, the security of a battery can be further improved. As such positive electrode active material, there can be used lithium-cobalt oxide such as LiCoO_2 , lithium-manganese oxide such as LiMn_2O_4 , lithium-nickel oxide such as LiNiO_2 , metal oxide such as lithium manganese-nickel complex oxide, lithium manganese-nickel-cobalt complex oxide, manganese dioxide, vanadium pentoxide, chrome oxide, lithium-titanium oxide, or a mixture of these metal oxides, or metal sulfide such as titanium disulfide, molybdenum disulfide, and the like, and so on, for example.

[0040]

In particular, it is desirable to use, as a positive electrode active material, lithium complex oxide that shows open-circuit voltage of 4 V or more by Li standard at the time of charging, such as LiNiO_2 , LiCoO_2 , LiMn_2O_4 , lithium manganese-nickel-cobalt complex oxide, and a mixture of these oxides and the like, because a lithium secondary battery of high energy density can be obtained.

[0041]

In addition, as the above-mentioned positive electrode, there are used ones made by applying a mixture prepared by adding a conductive assistant and a binder, such as polyvinylidene fluoride, and the like to a positive electrode active material accordingly on a current collector material such as aluminum foil and forming it into a strip-shaped compact, for example. In this regard, however, a manufacturing method of a positive electrode is not limited only to ones of the above-mentioned illustration.

[0042]

Also, as a negative electrode active material used for the above-mentioned negative electrode, it is preferred to use a compound capable of occluding and releasing lithium. By this, the security of a battery can be further improved. As such negative electrode active material, a carbon material and metal capable of alloying with lithium, such as Si and Sn, or their alloys and the like can be used, for example, and it is preferred to use a carbon material in particular. The reason for this is that a carbon material is superior in charging and discharging characteristics. As such carbon material, graphite, pyrolytic carbons, cokes, glassy carbons, a burned substance of an organic high-polymer compound, mesocarbon microbeads, carbon fiber, activated carbon, and the like can be used, for example.

[0043]

The above-mentioned carbon material preferably has interplanar spacing d_{002} of surface (002) of 0.350 nm or less, more preferably 0.345 nm or less, and further preferably 0.340 nm or less. The reason for this is that, a high capacity battery can be realized by this. Meanwhile, although no particular limitation is imposed on the lower limit value of d_{002} , it is approximately 0.335 nm theoretically. Furthermore, it is preferred that a size L_c of a crystallite in the c axis direction in the crystal structure of a carbon material be 3 nm or more, more preferably 8 nm or more, further preferably 25 nm or more. The reason is that, if it is in this range, occlusion and releasing of lithium becomes more easily. The upper limit of L_c is not particularly limited, and is usually around 200 nm.

[0044]

An average grain diameter of the above-mentioned carbon material is preferably 3 μm or more to 15 μm or less, and, more preferably, 10 μm or more to 13 μm or less, and its purity is preferably 99.9% or more. The reason for this is that, if it is within this range, it is easily available.

[0045]

As the above-mentioned negative electrode, there are used ones made by applying a mixture prepared by adding a conductive assistant and a binding agent and the like accordingly to a negative electrode active material as needed to a current collector material such as copper foil, and forming it to a strip-shaped compact, for example. In this regard, however, a manufacturing method of a negative electrode is not limited only to the one illustrated above."

"[0057]

Next, an example of a nonaqueous electrolyte secondary battery of the present invention will be described based on a drawing. FIG. 1 is a schematic sectional view showing an example of an electrode structure of a nonaqueous electrolyte secondary battery of the present invention, and FIG. 2 is a schematic sectional view in which a part of the negative electrode indicated in FIG. 1 has been enlarged.

[0058]

In FIG. 1, a separator 3 is arranged between a positive electrode 1 and a negative electrode 2, and a porous layer 4 is arranged on the surface of the negative electrode 2 in the side of the separator 3. In addition, the positive electrode 1 is arranged on a collector 5 made of aluminum foil in a unified manner, for example, and the negative electrode 2 is arranged on a collector 6 made of copper foil in a unified manner, for example. The details of the positive electrode 1, the negative electrode 2, the separator 3, and the porous layer 4 are as described above, and their repeated descriptions will be omitted. Although, in FIG. 1, an example in which the porous layer 4 is formed on the surface of the negative electrode 2 is indicated, it may be formed on the surface of the positive electrode 1, or may be formed on both the positive electrode 1 and the negative electrode 2.

[0059]

In FIG. 2, the porous layer 4 including an electron-conductive material 7 of a particle shape is arranged on a surface of the negative electrode 2. The details of the electron-conductive material 7 are also as described above, and its repeated description will be omitted. Although FIG. 2 indicates an example in which the negative electrode 2 is formed on one surface of the collector 6, it may be formed on both surfaces of the collector 6."

"[Examples]

[0062]

Hereinafter, the present invention will be described more specifically based on examples. In this regard, however, the present invention is not limited only to the following examples.

[0063]

(Example 1)

As shown in the following, fabrication of an electrode, a porous layer, and a battery was performed.

[0064]

<Fabrication of electrodes>

A positive electrode was produced as follows. First, scale-shaped graphite of 5 parts by mass was added as a conductive assistant to LiCoO₂ (a positive electrode active material) of 92 parts by mass to be mixed, and a solution made by dissolving polyvinylidene fluoride (binder) of 3 parts by mass in N-methyl pyrrolidone (NMP) was added to this mixture and mixed to prepare positive electrode mixture slurry. After removal of grains of a large diameter by making this positive electrode mixture slurry pass a net of 100 mesh, this positive electrode mixture slurry was coated uniformly on both surfaces of a positive electrode collector composed of aluminum foil of a thickness of 15 μm and dried, and was compression-molded by a roll press machine and its total thickness was adjusted to 160 μm to obtain a positive electrode sheet. After that, this positive electrode sheet was cut as a sheet of 150 mm length and 120 mm breadth, and a lead made of aluminum was welded to produce a positive electrode of a rectangular shape. The electrical capacitance of this positive electrode was made to be 1000 mAh in both-side total.

[0065]

Using mesocarbon microbeads (MCMB) having a BET specific surface area of 0.4 m²/g as a negative electrode active material, and using polyvinylidene fluoride

(PVDF) as a binder, MCMB and PVDF were mixed at the ratio of 95:5 by mass ratio, and, further, NMP was added and mixed to prepare negative electrode mixture paste. This negative electrode mixture paste was applied evenly on both surfaces of a negative electrode collector made of copper foil of a thickness of 10 μm and then dried, and, after that, was compression-molded by a roll press machine and its total thickness was adjusted to 146 μm to obtain a negative electrode sheet.

[0066]

<Formation of porous layer>

Carbon black of 60 parts by mass, low density polyethylene of 30 parts by mass, and polyethylene fine powder wax of 10 parts by mass were mixed, and milled by a jet mill so as to make grain diameters be 1 μm to 5 μm to prepare an electron-conductive material having Curie temperature of about 100 degrees C. This electron-conductive material has volume specific resistivity of 0.2 Ωcm at 25 degrees C, and volume specific resistivity of 20 Ωcm at 100 degrees C, and has a PTC characteristic.

[0067]

Next, this electron-conductive material of 97 parts by mass and PVDF (binder) of 3 parts by mass were dispersed in NMP that is a dispersion medium to obtain a slurry. This slurry was applied on both surfaces of a negative electrode sheet produced in advance, and NMP was evaporated and dried to form porous layers on both surfaces of the negative electrode. After that, the negative electrode sheet to which porous layers were formed was vacuum-dried at 100 degrees C, and then, after being compression-molded by a roll press machine, was cut into 153 mm length, and 123 mm breadth, and a lead made of nickel was welded to it to produce a negative electrode of a rectangular shape. The electrical capacitance of this negative electrode was made to be 1130 mAh in both-side total.

[0068]

The thickness of porous layers of this negative electrode was measured using an electron microscope, and found to be about 10 μm . In addition, the porosity of this porous layer was measured by a mercury porosimeter "Pore sizer 9310" (product name), product of Micromeritics Instrument Corporation, and was found to be 48%.

[0069]

<Fabrication of battery>

First, as a nonaqueous electrolyte, an electrolyte made by dissolving LiPF_6 of 1.0 mol/L in a mixed solvent having a volume ratio of dimethyl carbonate and ethylene carbonate of 3:7 was prepared.

[0070]

Next, two microporous polyethylene films (hole area ratio of 41%) of thickness 25 μm , length 155 mm, and breadth 125 mm were stacked, and three sides of its periphery were thermal-welded to produce a bag-like separator. The above-mentioned positive electrode was inserted into this bag-like separator to prepare a positive electrode with the separator. Next, four pieces of such positive electrode with a separator and five pieces of the above-mentioned negative electrode were laminated alternately so that a lead of a positive electrode and a lead of a negative electrode did not overlap with each other to produce an electrode laminated body of a flat shape. Subsequently, the leads of respective positive electrodes were bundled and were ultrasonic-welded to a positive electrode terminal (of length 30 mm, breadth 20 mm,

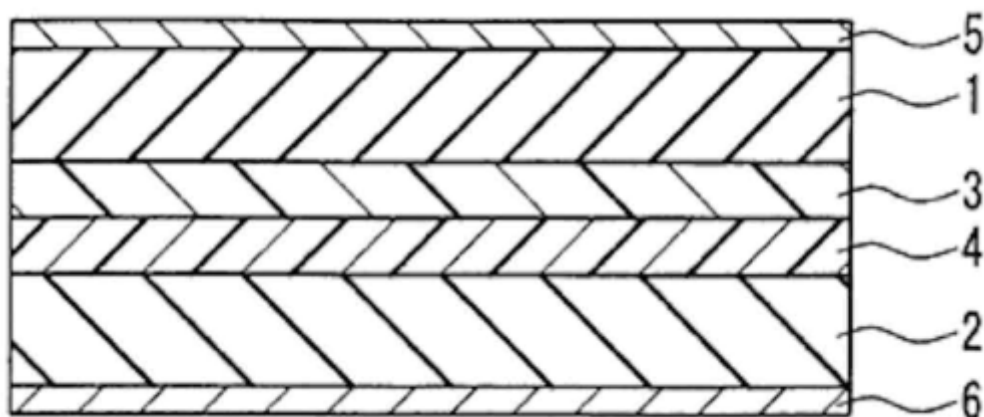
and thickness 0.01 mm) made of aluminum, and, further, the leads of respective negative electrodes were bundled and ultrasonic-welded to a negative electrode terminal (of length 30 mm, breadth 20 mm, and thickness 0.01 mm) made of nickel.

[0071]

Next, this electrode laminated body with the terminals was inserted into a laminate film case of a trilaminar structure made of polyester film-aluminum foil-modified polyolefin film of length 175 mm, breadth 145 mm, and thickness 0.07 mm. Subsequently, the above-mentioned nonaqueous electrolyte was injected from the opening of the laminate film case, and, after the nonaqueous electrolyte had sufficiently penetrated to the separator and the like, the opening was thermal-welded to be sealed. After that, pre-charging and aging were performed, and a nonaqueous electrolyte secondary battery of a structure similar to that indicated in FIG. 4 was produced."

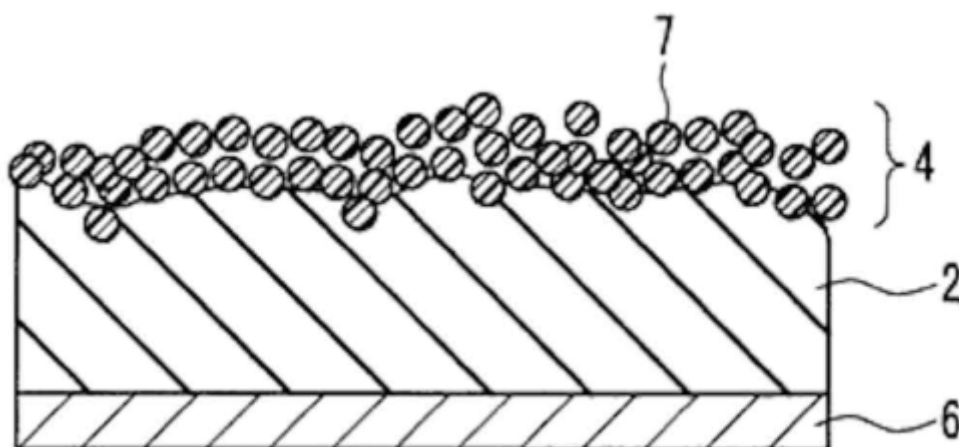
C Description of drawings

"[FIG. 1]



"

"[FIG. 2]



"

(1-1) Cited invention based on the statement of claim 1 of Cited Document 1

A A "nonaqueous electrolyte secondary battery" of claim 9 that refers to claim 1 is "a nonaqueous electrolyte secondary battery, including: a positive electrode; a negative electrode; a separator arranged between the positive electrode and the negative electrode; and a nonaqueous electrolyte, wherein a porous layer is arranged on a surface of a separator side of at least one electrode selected from the positive electrode and the negative electrode, and wherein the porous layer includes an electron-conductive material having a Curie temperature of 40 degrees C or more to 200 degrees C or less", and "the separator includes polyolefin".

B According to [0041] of the above-mentioned (1)B, regarding "positive electrode" of "nonaqueous electrolyte secondary battery", it says "there are used ones made by applying a mixture prepared by adding a conductive assistant and a binder, such as polyvinylidene fluoride, and the like to a positive electrode active material accordingly on a current collector material such as aluminum foil and forming it into a strip-shaped compact", and, thus, it can be said that "positive electrode" of "nonaqueous electrolyte secondary battery" of claim 9 is made by forming a layer including a positive electrode active material on a current collector material.

C Regarding "negative electrode" of "nonaqueous electrolyte secondary battery", [0045] of the above-mentioned (1)B says "there are used ones made by applying a mixture prepared by adding a conductive assistant and a binding agent and the like accordingly to a negative electrode active material as needed to a current collector material such as copper foil, and forming it to a strip-shaped compact", and thus it can be said that "negative electrode" of "nonaqueous electrolyte secondary battery" of claim 9 is made by forming a layer including a negative electrode active material on a current collector material.

D Regarding "electron-conductive material" of "nonaqueous electrolyte secondary battery", [0015] of the above-mentioned (1)B says "electron-conductive material is a high-polymer material to which electron conductivity is given can be used." In addition, regarding "high-polymer material", [0017] of the above-mentioned (1)B says "As the above-mentioned high-polymer material, a high-polymer compound to which a conductivity imparting agent is added is suitably used." Further, regarding "high-polymer compound", [0018] of the above-mentioned (1)B says "high-density polyethylene are used". Therefore, it can be said that "electron-conductive material" of "nonaqueous electrolyte secondary battery" of claim 9 includes high-density polyethylene.

E Since it is the common general technical knowledge that high-density polyethylene has a density of 0.94-0.96 g/cm³ (see "Iwanami Rikagaku Jiten", the ninth printing of the fourth edition, IWANAMI SHOTEN, issued on Jul. 18, 1994, page 1234, "polyethylene" section), it is obvious that high-density polyethylene included in "electron-conductive material" of "nonaqueous electrolyte secondary battery" of claim 9 also has a density of 0.94-0.96 g/cm³.

F Regarding "high-polymer compound" and "conductivity imparting agent" of "electron-conductive material" of "nonaqueous electrolyte secondary battery",

According to [0025] of the above-mentioned (1)B says "an added quantity of a conductivity imparting agent to be added to the above-mentioned high-polymer compound is relative to the total mass of the high-polymer material be 40-70 mass%." Thus, it can be said that, in "electron-conductive material" of "nonaqueous electrolyte secondary battery" of claim 9, an added quantity of a conductivity imparting agent to be added to the high-polymer compound is 40-70 mass% relative to the total mass of the high-polymer material. That is, the high-polymer compound is included 30-60 mass% relative to the total mass of the high-polymer material.

Then, according to the statement "the above-mentioned electron-conductive material is a high-polymer material to which electron conductivity is given can be used" of [0015] of the above-mentioned (1)B, it can be said that "a high-polymer material to which electron conductivity is given" is "electron-conductive material." And, according to the above-mentioned D, "high-polymer compound" of "electron-conductive material" of "nonaqueous electrolyte secondary battery" of claim 9 is high-density polyethylene. Therefore, it can be said that "electron-conductive material" of "nonaqueous electrolyte secondary battery" of claim 9 contain 30-60 mass% of high-density polyethylene for the total mass of the electron-conductive material.

G According to [0065] of the above-mentioned (1)B, which is Example 1 in Cited Document 1, regarding "negative electrode" of "nonaqueous electrolyte secondary battery", it is disclosed that a negative electrode sheet was obtained by applying a negative electrode mixture paste made of a negative electrode active material, binder, and NMP on both surfaces of a negative electrode collector evenly, drying it, and performing compression-molding. Furthermore, according to [0067] of the above-mentioned (1)B, regarding "negative electrode" and "electron-conductive material" of "nonaqueous electrolyte secondary battery", it is disclosed that slurry in which an electron-conductive material and binder are dispersed in a dispersion medium was applied on both surfaces of a negative electrode sheet and dried to form porous layers on both surfaces of the negative electrode, the negative electrode sheet on which the porous layers had been formed was vacuum-dried, and then, after compression-molding by a roll press machine, cut to a length of 153 mm and a breadth of 123 mm, and a lead made of nickel was welded to it to produce a negative electrode of a rectangular shape.

In other words, that negative electrode was cut into a rectangular shape after coating a layer including an electron-conductive material on a negative electrode sheet to which a layer including a negative electrode active material had been applied, and, therefore, it can be said that the area of the layer including the negative electrode active material and the layer including the electron-conductive material are the same.

In addition, Example 2 shows a porous layer including an electron-conductive material is formed on a positive electrode (see: [0073]-[0074]), Example 3 and Example 4 are examples show, in the same manner as Example 1, a negative electrode with a porous layer including an electron-conductive material is fabricated (see: Example 3 in [0078]-[0079] and Example 4 in [0082]), and, thus, in Cited Document 1, there exists no other statement regarding the area of a layer including a negative electrode active material, and the area of a layer including an electron-conductive material.

Then, in "negative electrode" of "nonaqueous electrolyte secondary battery" of

claim 9, it can be said that a layer including a negative electrode active material and a layer including an electron-conductive material have the same area.

H Regarding "nonaqueous electrolyte secondary battery", [0010] of the above-mentioned (1)B says "An example of a nonaqueous electrolyte secondary battery of the present invention is a nonaqueous electrolyte lithium secondary battery", and there is no other specific statement as to a nonaqueous electrolyte secondary battery. Thus, "nonaqueous electrolyte secondary battery" of claim 9 is considered to be a nonaqueous electrolyte lithium secondary battery.

I According to the above-mentioned A-H, it is recognized that Cited Document 1 discloses the following invention (hereinafter, referred to as "Cited invention 1").

"A nonaqueous electrolyte lithium secondary battery, comprising: a positive electrode having a layer including a positive electrode active material formed on a current collector material; a negative electrode having a negative electrode active material layer formed on a current collector material; a separator arranged between the positive electrode and the negative electrode; and a nonaqueous electrolyte,

wherein, on a surface of at least one electrode selected from the positive electrode and the negative electrode on a side of the separator, a porous layer is arranged, the porous layer including an electron-conductive material having a Curie temperature of 40 degrees C or more to 200 degrees C or less,

wherein the separator includes polyolefin,

wherein the electron-conductive material includes high-density polyethylene having a density of 0.94-0.96 g/cm³,

wherein an amount of high-density polyethylene of the electron-conductive material is 30-60 mass% relative to a total mass of the electron-conductive material,

wherein the layer including the negative electrode active material and the layer including the electron-conductive material have a same area."

(1-2) Cited invention based on the Example 1 in Cited Document 1

A The paragraphs [0063]-[0071] of the above-mentioned (1)B relate to "nonaqueous electrolyte secondary battery" of Example 1.

In addition, although it is not clearly described what kind of nonaqueous electrolyte secondary battery the "nonaqueous electrolyte secondary battery" of Example 1 is. According to [0010] of the above-mentioned (1)B, it is disclosed that an example of "nonaqueous electrolyte secondary battery" is a "nonaqueous electrolyte lithium secondary battery", and, considering that there is no other specific statement as to a nonaqueous electrolyte secondary battery, it can be said that "nonaqueous electrolyte secondary battery" of Example 1 is a "nonaqueous electrolyte lithium secondary battery".

B According to [0070] of the above-mentioned (1)B, regarding "electrode laminated body" of "nonaqueous electrolyte secondary battery", it was fabricated by laminating four separator-added positive electrodes, each having a positive electrode being inserted into a bag-like separator, and five negative electrodes.

C Regarding "positive electrode" of "nonaqueous electrolyte secondary battery",

according to [0064] of the above-mentioned (1)B, a rectangular-shaped positive electrode was fabricated by coating a positive electrode mixture slurry made by adding a conductive assistant to a positive electrode active material and dissolving the mixture in solution on both surfaces of a positive electrode collector to obtain a positive electrode sheet, and, after that, by cutting this positive electrode sheet to a length 150 mm and a breadth 120 mm.

D Regarding "negative electrode sheet" of "nonaqueous electrolyte secondary battery", according to [0065] of the above-mentioned (1)B, a negative electrode mixture paste made by mixing a negative electrode active material and binder and adding solution is applied on both surfaces of a negative electrode collector to obtain a negative electrode sheet.

E About "negative electrode" of "nonaqueous electrolyte secondary battery", according to [0066] and [0067] of the above-mentioned (1)B, 60 parts by mass carbon black, 30 parts by mass low density polyethylene, and 10 parts by mass polyethylene fine powder wax were mixed to prepare an electron-conductive material of a Curie temperature of about 100 degrees C, the electron-conductive material and binder were dispersed in a dispersion medium to obtain a slurry, this slurry was applied on both surfaces of a negative electrode sheet to form a porous layer on both surfaces of a negative electrode, and, after that, the sheet was cut to a length 153 mm and a breadth of 123 mm to fabricate a rectangular-shaped negative electrode.

Furthermore, according to [0021] and [0022] of the above-mentioned (1)B, the carbon black is a conductivity imparting agent, and, according to [0018] of the above-mentioned (1)B, low density polyethylene and polyethylene fine powder wax are a high-polymer compound.

F Regarding "separator" of "nonaqueous electrolyte secondary battery", according to [0070] of the above-mentioned (1)B, a bag-like separator of a microporous polyethylene film was used.

G According to the above-mentioned C, it can be said that "positive electrodes" of "nonaqueous electrolyte secondary battery" are formed on both surfaces of a positive electrode collector that includes positive electrode active material.

H According to the above-mentioned D, it can be said that "negative electrode sheets" of "nonaqueous electrolyte secondary battery" are formed on both surfaces of a negative electrode collector that includes negative electrode active material.

I According to the above-mentioned E and H, it can be said that "negative electrodes" of "nonaqueous electrolyte secondary battery" contain porous layers with electron-conductive material on a negative electrode sheet and on the negative electrode sheet, a layer with negative electrode active material is formed on both surfaces of a negative electrode sheet.

J According to the above-mentioned D and E, "negative electrode" of "nonaqueous electrolyte secondary battery" was fabricated in a manner that a negative electrode

active material and binder was mixed, a solution was added to the mixture to make negative electrode mixture paste, the paste was applied on both surfaces of a negative electrode collector to obtain a negative electrode sheet, and then, an electron-conductive material and binder were dispersed in a dispersion medium to obtain a slurry, this slurry was applied on both surfaces of the negative electrode sheet to form porous layers on both surfaces of the negative electrode, and, after that, it was cut to a sheet of a length of 153 mm and a breadth of 123 mm, and, therefore, it can be said that a layer including a negative electrode active material and a porous layer including an electron-conductive material have the same area.

K According to the above-mentioned B, it can be said that "separator" of "nonaqueous electrolyte secondary battery" intervenes between the positive electrode and the negative electrode.

L According to the above-mentioned E, "electron-conductive material" of "nonaqueous electrolyte secondary battery" is one prepared by mixing 60 parts by mass carbon black that is a conductivity imparting agent, 30 parts by mass low density polyethylene that is a high-polymer compound, and 10 parts by mass polyethylene fine powder wax, and its Curie temperature is about 100 degrees C.

M According to the above-mentioned A-L, it is recognized that Cited Document 1 discloses the following invention (hereinafter, referred to as "Cited invention 2").

"A nonaqueous electrolyte lithium secondary battery comprising an electrode laminated body fabricated by laminating: four separator-added positive electrodes, each having a positive electrode being inserted into a bag-like separator; and five negative electrodes, the electrode laminated body comprising:

- a positive electrode comprising a layer including a positive electrode active material, the layer being formed on both surfaces of a positive electrode collector;

- a negative electrode comprising a porous layer including an electron-conductive material, the porous layer being formed on both surfaces of a negative electrode sheet including a layer including a negative electrode active material formed on both surfaces of a negative electrode collector, wherein the layer including the negative electrode active material and the porous layer including the electron-conductive material have the same area; and

- a bag-like separator of a microporous polyethylene film, the separator intervening between the positive electrode and the negative electrode,

- wherein the electron-conductive material is prepared by mixing 60 parts by mass carbon black, the carbon black being a conductivity imparting agent, 30 parts by mass low density polyethylene, the low density polyethylene being a high-polymer compound, and 10 parts by mass polyethylene fine powder wax, and has Curie temperature of about 100 degrees C."

(2) Cited publication 2

Furthermore, in "Japanese Unexamined Patent Application Publication No. 2004-327183" (hereinafter, referred to as "Cited Document 2"), which was distributed on Nov. 18, 2004 before the priority date of the present application, the followings are described. The underlines are added by the body.

A The statements of the detailed explanation of the invention

"[0001]

[Technical Field]

The present invention relates to a battery including a separator superior in heat resistance and ion conductivity, and an electrode capable of suppressing increase of short circuit current.

[0002]

[Conventional Art]

In recent years, along with the development of portable electronic devices, batteries used as their power sources are becoming ones of higher capacity and higher output density. As a battery that satisfies these requirements, a lithium ion secondary battery is drawing attention. A lithium secondary battery is of high voltage and high energy density, and, thus, there is a need for sufficient countermeasures against abnormal heat generation due to an internal short circuit, an external short circuit, and the like.

In a lithium secondary battery that has been put to practical use at the moment, one made by mixing active material powder such as lithium-cobalt complex oxide, electron conductivity powder, and binder resin to make the mixture be like paste, and applying the paste on an aluminum collector is used as a positive electrode; one made by mixing active material powder such as of the carbon system and binder resin to make the mixture be like paste, and applying the paste on a copper collector is used as a negative electrode; and a porous film including polyolefin system resin having a melting point of 120-160 degrees C is used as a separator. In such battery, there is taken a countermeasure in which, when abnormal heat generation occurs by a short circuit and the like, resin melts and micro pores within the film are occluded, causing decrease of ion conductivity of a separator, thereby blocking such short circuit current. However, if the temperature rises further exceeding the melting point of the resin, the resin melts and is fluidized, causing shrinkage of the separator itself or generation of a large hole in the separator. By this, there is a risk that insulation between a positive electrode and a negative electrode becomes insufficient to lead to an internal short-circuit.

[0003]

Therefore, there has been proposed a battery that uses a porous separator superior in heat resistance, the porous separator including an aggregation of an insulating material particles such as inorganic oxide having a melting point of 1000 degrees C or more, and binder resin having a melting point of about 200 degrees C (refer to patent document 1, for example). In addition, there has been proposed a battery to make current at the time of an abnormal rise of the temperature be reduced by using an electrode having an active material layer whose resistance becomes large in association with a rise in the temperature of the battery, (for example, refer to patent document 2).

[0004]

[Patent document 1]

International Publication No. WO 97/08763 brochure

[Patent document 2]

International Publication No. WO 99/40640 brochure

[0005]

[Problems to be solved by the invention]

However, there are problems that, in the case of a battery using a porous separator superior in heat resistance mentioned above, it does not have a function to block battery

reaction on the occasion of abnormal temperature rise of the battery due to a short circuit and the like because a melting point of the porous separator is high, and that, in the case of a porous separator being made to contain a low melting point material, although it has a function to block battery reaction on the occasion of abnormal temperature rise, it becomes unable to be used as a battery again even if the temperature lowers, because the porous separator inevitably clogs once this function works. In addition, in the above-mentioned battery using an electrode whose resistance becomes large in association with a battery temperature rise, a material having heat resistance is not used in a separator, and, therefore, there is a problem that the separator clogs on the occasion of an abnormal temperature rise of the battery due to a short circuit and the like, and, even if the temperature lowers, it becomes unable to be used as a battery any more.

[0006]

The present invention is one that has been made in order to solve the above-mentioned problems, and its object is to provide a battery including a separator superior in ion conductivity and heat resistance, and an electrode including an active material layer including a material having a reaction blocking function or a current blocking function at 90 degrees C to 160 degrees C, and a manufacturing method thereof.

[0007]

[Means for Solving the Problem]

The present invention provides a battery including a separator holding an electrolyte, and electrodes arranged on both surfaces of the separator holding the electrolyte, each of the electrodes including an active material layer, wherein the separator holding an electrolyte has ion conductivity, includes a material having heat resistance of 160 degrees C or higher, and at least any one of the active material layers includes a material having a reaction blocking function or a current blocking function at 90 degrees C to 160 degrees C.

[0008]

[Modes for Carrying out the Invention]

FIG. 1 is a sectional view of a battery according to the present embodiment. In FIG. 1, a battery includes a separator 3 holding electrolyte, a positive electrode 1 arranged on one surface of the separator 3 holding electrolyte, the positive electrode 1 having a positive electrode active material layer 6, and a negative electrode 2 arranged on the other surface of the separator 3 holding electrolyte, the negative electrode 2 having a negative electrode active material layer 7. Then, the separator 3 holding electrolyte is one including insulating particles and matrix resin, or including a porous resin film having a melting point of 160 degrees C or higher, and at least any one of the active material layers 6 and 7 includes an active material 8, a PTC conducting material 9, and a binder 10. In addition, the positive electrode has a positive electrode collector 4, the negative electrode has a negative electrode collector 5, and an electrolyte solution 11 is impregnated in the separator holding an electrolyte. Then, the electrode, the separator holding an electrolyte, and the electrolyte solution are contained in a battery container 12.

[0009]

[Electrode]

An electrode in the present embodiment includes an active material layer including a material having a reaction blocking function or current blocking function at 90 degrees

C to 160 degrees C. This reaction blocking function indicates a function to, at a predetermined temperature, block reaction of an active material by, for example, coating the surface of active material, or a function to block traveling of electrolyte ion by, for example, occluding the paths of ion, and a current blocking function indicates a function to block a flow of electron in an electrode by, for example, increase in the resistance of the electrode at the predetermined temperature. More specifically, a material having a reaction blocking function or current blocking function at 90 degrees C to 160 degrees C is one that includes an electrode active material, a PTC conducting material, and binder. That active material layer is arranged on a collector.

In the present embodiment, as an active material used for a positive electrode, there can be cited lithium complex oxide of transition metal such as cobalt, manganese, or nickel, and lithium complex oxide of these containing various kinds of additive elements; lithium complex oxide of metal such as copper, iron, chrome, titanium, or aluminum, and lithium complex oxide of these containing various kinds of additive elements; a complex compound such as lithium and vanadium, lithium and molybdenum, lithium and chalcogen, and these complex compounds having various kinds of additive elements, and a complex polymer such as polypyrrole, polyaniline, or polydisulfide, and these can be used independently or as a combination of two or more kinds of them, for example. A proportion of a positive electrode active material included in an active material layer is preferably 50 weight% to 98 weight%, and, more preferably, 70 weight% to 98 weight%.

An average particle diameter of an active material used for a positive electrode is preferably 0.05-100 μm , more preferably, 0.1-50 μm . If it is within this range, filling density of an active material is increased, and, contact with other materials becomes well, and, thus, battery characteristics can be improved.

As an active material used for a negative electrode, there can be cited a carbonaceous material such as easily graphitizable carbon, hardly graphitizable carbon, natural graphite, synthetic graphite, polyacene, an alloy compound of the tin system such as V-Sn, Cu-Sn, Fe-Sn, Sn-S₂, and SnO, oxide of the boron system, and nitride such as Li_{2.6}Co_{0.4}N, for example, and can be used regardless of chemical characteristics. Among these, ones having a granular shape are used. A proportion of a negative electrode active material included in an active material layer is preferably 50 weight% to 98 weight%, more preferably 70 weight% to 98 weight%. An average particle diameter of an active material used for a negative electrode is preferably 0.05 to 100 μm , more preferably, 0.1 to 50 μm . If it is within this range, filling density of the active material is increased, and contact with other materials becomes well, thereby enabling improvement of battery characteristics. Furthermore, as a negative electrode active material, metal lithium can be also used, and it may be either of a granular shape and a foil shape.

[0010]

In addition, in order to compensate for conductivity of the above-mentioned positive electrode active material and negative electrode active material, a conductive assistant may be used in combination. As a conductive assistant, a carbonaceous material such as acetylene black, Ketjenblack, or synthetic graphite, a metal material, a metal compound having conductivity, or high-polymer having conductivity can be cited, for example.

[0011]

In the present embodiment, a PTC (Positive Temperature Coefficient) conducting material means a material having characteristics that, within a predetermined temperature range, especially at a temperature around 90 degrees C to 160 degrees C, a change rate of its resistance value increases, thereby making the resistance be large (hereinafter, it is abbreviated as PTC characteristic). By this PTC conducting material being included in an active material layer, it is possible to make short circuit current be reduced when the temperature of an electrode rises to 90 degrees C to 160 degrees C. This PTC conducting material includes, for example, ceramic system materials and complex materials containing a conductive filling material and crystalline resin. In the case of a ceramic system material, a PTC characteristic is developed by a structure change of the ceramic material itself due to temperature (a structure transition at Curie temperature). In the case of a complex material containing a conductive filling material and crystalline resin, by the crystalline resin being softened, melted, and expanded in volume, a resistance value of itself rises. Accordingly, it is possible to adjust a temperature at which a PTC characteristic is shown by changing a kind of crystalline resin, because a temperature at which a PTC characteristic is shown depends on the melting point of the crystalline resin included in a PTC conducting material. Although it is desirable that this temperature at which PTC characteristic is shown be 90 degrees C or less from a viewpoint of securing security, it means that a resistance value of an electrode rises in a temperature range of usual battery usage, and, thus, decline of battery performance is caused. In addition, when a temperature at which a PTC characteristic is shown exceeds 160 degrees C, this leads to rising of a battery internal temperature to the temperature in question, and, thus, it is undesired from the point of view of safety. Accordingly, it is desirable to design a PTC conducting material so as to make a temperature at which a PTC characteristic is shown be in a range of 90 degrees C to 160 degrees C. On the other hand, the magnitude of resistance of an electrode at normal times (that is, before a PTC characteristic is shown) can be adjusted by changing the proportion of a PTC conducting material to an active material layer, and a rate of change of a resistance value ((a resistance value at 90 degrees C to 160 degrees C - a resistance value at normal times)/the resistance value at normal times) is preferably 1.5-10,000. A PTC conducting material in the present embodiment has reversibility by which the above-mentioned PTC characteristic can be expressed twice or more, and, after the PTC characteristic has been shown once, a resistance value is reduced again when the temperature is lowered. In the present embodiment, having reversibility means that, supposing that a change amount from a resistance value at normal times to a resistance value at the time of PTC characteristic expression is 100%, a resistance value when lowering the temperature after the PTC characteristic has been indicated becomes 90% or less.

[0012]

As a conductivity filling material, in addition to a carbon material such as carbon black, graphite, carbon fiber, and metal carbide, conductive non-oxide such as metal nitride, metal silicides, and metal boride can be cited, for example, and these can be used independently or as a combination of two or more kinds of them. Carbon black is acetylene black, furnace black, lamp black, or the like, for example. Metal carbide is, for example, TiC, ZrC, VC, VbC, TaC, Mo₂C, WC, B₄C, Cr₃C₂, or the like. Metal nitride is TiN, ZrN, VN, NbN, TaN, Cr₂N, or the like, for example. Metal boride is TiB₂, ZrB₂, NbB₂, TaB₂, CrB, MoB, WB, or the like, for example. A percentage of a

conductive filling material included in a PTC conducting material is preferably 30 weight% to 80 weight%, and if it is within this range, conductivity of an electrode can be further improved.

[0013]

A crystalline resin can be any resin that has a melting point of 90 degrees C to 160 degrees C, and that shows crystallinity, and, for example, there can be cited a polymer such as high-density polyethylene (melting point: 130 degrees C to 140 degrees C), low density polyethylene (melting point: 110 degrees C to 112 degrees C), polyurethane elastomer (melting point: 140 degrees C to 160 degrees C), and polyvinyl chloride (melting point: about 145 degrees C). A proportion of crystalline resin included in a PTC conducting material is preferably 20 weight% to 70 weight%, and, if it is within this range, it is possible to express a good PTC characteristic while maintaining conductivity of an electrode.

[0014]

Although no particular limitation is imposed on a method of producing a PTC conducting material, there is cited a method in which, after a conductive filling material and crystalline resin have been kneaded to be a pellet, the pellet is broken into fragments by a jet mill apparatus and a ball mill apparatus and the like, for example. Although a form of a PTC conducting material is preferably a particle-like form, it may be a fiber-like form or a scale-like form. In the case of a PTC conducting material being particle-like form, its average particle diameter is preferably 0.05 μm to 20 μm , more preferably, 0.1 μm to 10 μm . If it is within this range, a network is easily formed within a PTC conducting material, and, thus, it is possible to make resistance of an electrode at normal times smaller. A proportion of a PTC conducting material included in an active material layer is preferably 0.5 parts weight to 15 parts weight relative to the total dissolved solid of the active material layer of 100 parts weight, and, more preferably, 0.7 parts weight to 12 parts weight. If it is within this range, it is possible to make resistance of an electrode at normal times small, and, at the same time, discharge capacity of the battery high.

[0015]

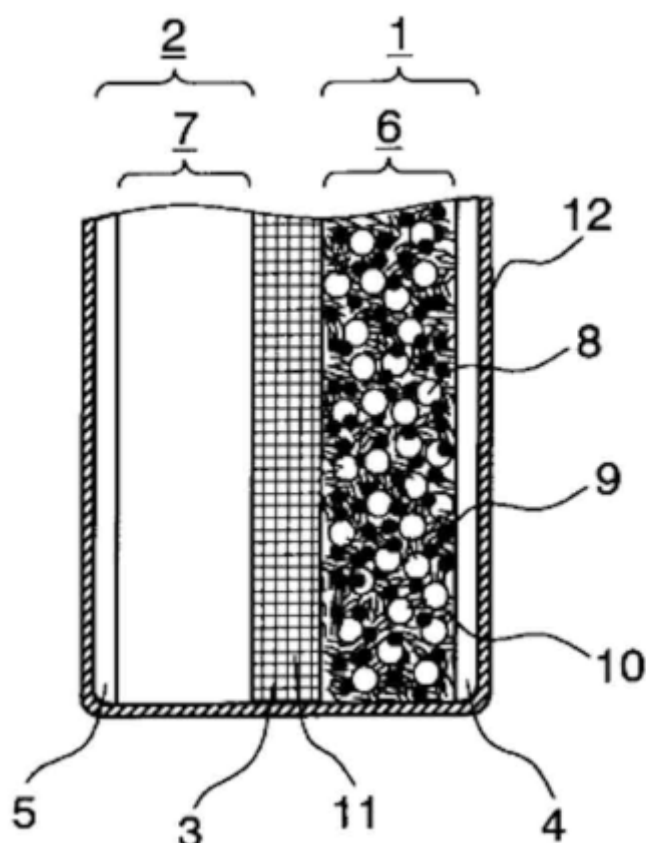
A binder can be any binder so long as it is one that can bond materials constituting an active material layer such as an active material, a PTC conducting material, and a conductive assistant, and, in addition, can adhesively bonding an active material layer and a collector, and there can be cited a homopolymer or a copolymer such as vinylidene fluoride, ethylene tetrafluoride, acrylonitrile, ethylene oxide, styrene-butadiene rubber, and the like can be cited. In particular, by using binder having a melting point of 90 degrees C to 160 degrees C, short circuit current can be reduced, because the binder melts in this temperature range, and adhesion properties between materials constituting an active material layer degrade to cause large electrode resistance. A proportion of binder included in active material layer is preferably 1 weight% to 20 weight%, more preferably 1 weight% to 10 weight%. If it is within this range, materials constituting an active material layer can be bonded efficiently.

[0016]

In the present embodiment, although a collector can be of any metal so long as it is stable within a battery, aluminum and copper are preferably used for a positive electrode and a negative electrode, respectively. Regarding a shape of a collector, a collector of any shape can be used, such as a shape of foil, a net, expanded metal, and the like. A

thickness of a collector is preferably 5 μm to 100 μm , more preferably, 5 μm to 25 μm . If it is within this range, a battery can be made thin while maintaining sufficient mechanical strength."

B Description of drawings
 "[FIG. 1]



C According to the statements of [0002] to [0007] of the above-mentioned A, it is obvious that "battery" of the above A and B is "lithium secondary battery" described in [0002].

D According to [0008] of the above-mentioned A, "lithium secondary battery" includes the positive electrode 1 having the positive electrode active material layer 6, and the negative electrode 2 having the negative electrode active material layer 7, and at least either one of the active material layers 6 and 7 includes the PTC conducting material 9, and, therefore, it can be said that it has the positive electrode 1 or the negative electrode 2 having the active material layers 6 and 7 including the PTC conducting material 9.

E According to [0011] of the above-mentioned A, in the case that a PTC conducting material of "lithium secondary battery" is a complex material containing a conductive filling material and crystalline resin, a temperature at which PTC

characteristic is shown depends on the melting point of the crystalline resin included in the PTC conducting material, and, thus, it can be said that a temperature at which the PTC characteristic is shown can be adjusted by changing a kind of crystalline resin.

F According to [0011] and [0013] of the above-mentioned A, as a crystalline resin of a PTC conducting material of "lithium secondary battery", high-density polyethylene (melting point: 130 degrees C to 140 degrees C) can be cited, for example.

G The matters disclosed in Cited Document 2

According to the above-mentioned C-F, the Cited Document 2 discloses the following matters.

"In a lithium secondary battery,

in the case of the lithium secondary battery including a positive electrode or a negative electrode having an active material layer including a PTC conducting material, and

the PTC conducting material is a complex material containing a conductive filling material and crystalline resin, a temperature of the PTC conducting material at which a PTC characteristic is shown depends on the melting point of the crystalline resin included in the PTC conducting material, and, therefore, the temperature at which the PTC characteristic is shown can be adjusted by changing a kind of crystalline resin, and

as crystalline resin, high-density polyethylene (melting point: 130 degrees C to 140 degrees C) can be cited, for example."

5 Comparison and Judgment by the body

5-1 When Cited invention 1 is the main citation

The Amended Invention will be compared with Cited invention 1.

(1) "Layer including a positive electrode active material", "current collector material" of "positive electrode", "layer including a negative electrode active material", and "current collector material" of "negative electrode" of Cited invention 1 correspond to "positive electrode active material layer", "positive electrode collector", "negative electrode active material layer", and "negative electrode collector" of the Amended Invention, respectively.

(2) "Positive electrode having a layer including a positive electrode active material formed on a current collector material" of Cited invention 1 corresponds to "positive electrode having a positive electrode active material layer formed on a positive electrode collector" of the Amended Invention.

(3) "Negative electrode having a layer including a negative electrode active material formed on a current collector material" of Cited invention 1 corresponds to "negative electrode having a negative electrode active material layer formed on a negative electrode collector" of the Amended Invention.

(4) "Separator" "arranged between the positive electrode and the negative electrode" and "comprising polyolefin" of Cited invention 1 corresponds to "polyolefin-based separation film interposed between the positive electrode and the negative electrode" of

the Amended Invention.

(5) "Porous layer" "including an electron-conductive material having a Curie temperature of 40 degrees C or more to 200 degrees C or less" of the Cited Invention corresponds to "PTC (Positive Temperature Coefficient) material layer" of the Amended Invention, because it is a layer of a material having a characteristic that, when Curie temperature is reached, its electric resistance drastically increases due to its positive temperature coefficient; that is, the PTC characteristic.

(6) "Electrode assembly for a secondary battery" of the Amended Invention "comprises: a positive electrode ...; a negative electrode ...; and a polyolefin-based separation film", and "PTC (Positive Temperature Coefficient) material layer is formed" in it, and "nonaqueous electrolyte lithium secondary battery" of the Cited Invention is one "comprising" "a positive electrode ...; a negative electrode ...; a separator ...", and in which "porous layer is arranged", "the porous layer including an electron-conductive material having a Curie temperature of 40 degrees C or more to 200 degrees C or less", and, therefore, it can be said that "nonaqueous electrolyte lithium secondary battery" of Cited invention 1 includes an assembly corresponding to "electrode assembly for a secondary battery" of the Amended Invention.

(7) In a secondary battery, it is the common general technical knowledge that an active material is formed on a surface of an electrode in the separator side, and, therefore, it can be said that "positive electrode active material layer" and "negative electrode active material layer" of the Amended Invention are formed on a surface of each of "positive electrode collector" and "negative electrode collector" in the separator side.

Then, the matter of Cited invention 1 "on a surface of at least one electrode selected from the positive electrode and the negative electrode on a side of the separator, a porous layer is arranged, the porous layer including an electron-conductive material having a Curie temperature of 40 degrees C or more to 200 degrees C or less" corresponds to the matter of the Amended Invention "a PTC (Positive Temperature Coefficient) material layer is formed on a top face of an active material layer of at least any one of the positive electrode and the negative electrode".

(8) The matter of Cited invention 1 "the layer including the negative electrode active material and the layer including the electron-conductive material have the same area" corresponds to the matter of the Amended Invention "the PTC material layer has the same area as that of each active material layer".

(9) "PTC composition" of the Amended Invention means, by itself, a composition in which a PTC phenomenon emerges. That is, "its resistance largely increases sharply as the temperature rises." (see [0025] of the description of the case) On the other hand, "electron-conductive material having a Curie temperature of 40 degrees C or more to 200 degrees C or less" of Cited invention 1 has the same property. That is, when Curie temperature is reached, electric resistance increases drastically due to its positive temperature characteristic coefficient." (see[0011] of Cited Document 1) Accordingly, "electron-conductive material" of Cited invention 1 corresponds to "PTC composition" of the Amended Invention.

Then, the matter of Cited invention 1 "the electron-conductive material includes high-density polyethylene having a density of 0.94-0.96 g/cm³, wherein an amount of high-density polyethylene of the electron-conductive material is 30-60 mass% relative to a total mass of the electron-conductive material" corresponds to the matter of the Amended Invention "the PTC material layer includes high-density polyethylene of 40 to 60 weight% of the total weight of a PTC composition, the high-density polyethylene having a density exceeding 0.94 g/cm³".

(10) "Nonaqueous electrolyte lithium secondary battery" of Cited invention 1 corresponds to "lithium secondary battery" of the Amended Invention.

According to the above-mentioned (1)-(10), the Amended Invention and Cited invention 1 are identical in

"A lithium secondary battery comprising an electrode assembly for a secondary battery, the electrode assembly comprising:

a positive electrode having a positive electrode active material layer formed on a positive electrode collector;

a negative electrode having a negative electrode active material layer formed on a negative electrode collector; and

a polyolefin-based separation film interposed between the positive electrode and the negative electrode,

wherein a PTC (Positive Temperature Coefficient) material layer is formed on a top face of an active material layer of at least either one of the positive electrode and the negative electrode, and the PTC material layer has the same area as that of each active material layer, and

wherein the PTC material layer includes high-density polyethylene of 40 to 60 weight% of the total weight of a PTC composition, the high-density polyethylene having a density exceeding 0.94 g/cm³.", and there are no different features.

Accordingly, since the Amended Invention is identical to the invention disclosed in Cited Document 1, and falls under the category of Article 29-1(3) of the Patent Act, the appellant should not have been granted a patent for it independently at the time when the patent application was filed.

5-2 When Cited invention 2 is the main citation

Next, the Amended Invention will be compared with Cited invention 2.

(1) "Layer including a positive electrode active material" and "layer including a negative electrode active material" of Cited invention 2 correspond to "positive electrode active material layer" and "negative electrode active material layer" of the Amended Invention, respectively.

(2) Since "an electrode laminated body fabricated by laminating four separator-added positive electrodes, each having a positive electrode being inserted into a bag-like separator, and five negative electrodes" of Cited invention 2 is "electrode laminated body" of "nonaqueous electrolyte lithium secondary battery", it corresponds to "electrode assembly for a secondary battery" of the Amended Invention.

(3) It can be said that "PTC composition" of the Amended Invention is, from its name, a composition in which the PTC phenomenon; that is, "a phenomenon that resistance largely increases sharply as the temperature rises" ([0025] of the description of the case) appears, and "electron-conductive material" that "has a Curie temperature of about 100 degrees C" of Cited invention 2 is a material having characteristics that electric resistance increases rapidly due to its positive temperature coefficient when the Curie temperature is reached; that is, the PTC characteristic. Therefore, it corresponds to "PTC composition" of the Amended Invention.

(4) Taking into consideration the above-mentioned (3), "porous layer including an electron-conductive material" of Cited invention 2 corresponds to "PTC (Positive Temperature Coefficient) material layer" of the Amended Invention.

(5) "Positive electrode comprising a layer including a positive electrode active material, the layer being formed on both surfaces of a positive electrode collector" of Cited invention 2 corresponds to "positive electrode having a positive electrode active material layer formed on a positive electrode collector" of the Amended Invention.

(6) "Negative electrode" of Cited invention 2 having "negative electrode sheet including a layer including a negative electrode active material formed on both surfaces of a negative electrode collector" corresponds to "negative electrode having a negative electrode active material layer formed on a negative electrode collector" of the Amended Invention.

(7) Since it is the common general technical knowledge that polyethylene is an example of polyolefin, "bag-like separator of a microporous polyethylene film, the separator intervening between the positive electrode and the negative electrode" of Cited invention 2 corresponds to "polyolefin-based separation film interposed between the positive electrode and the negative electrode" of the Amended Invention.

(8) In Cited invention 2, "the porous layer including an electron-conductive material is formed on both surfaces of a negative electrode sheet including a layer including a negative electrode active material formed on both surfaces of a negative electrode collector", and, therefore, Cited invention 2 is an invention that has the matter of the Amended Invention that "PTC (Positive Temperature Coefficient) material layer is formed on a top face of an active material layer of at least either one of the positive electrode and the negative electrode".

(9) In the Amended Invention, "a PTC (Positive Temperature Coefficient) material layer is formed" on "at least any one of the positive electrode and the negative electrode", and, therefore, the matter of Cited invention 2 "the layer including the negative electrode active material and the porous layer including the electron conductive material have the same area" corresponds to the matter of the Amended Invention "the PTC material layer has the same area as that of each active material layer".

(10) "Low density polyethylene" and "polyethylene fine powder wax" of "electron-conductive material" of Cited invention 2, and "high-density polyethylene" of

"PTC material layer" of the Amended Invention are in common in a point of being a high-polymer compound included in a PTC composition.

Then, since "electron-conductive material" of Cited invention 2 "is prepared by mixing 60 parts by mass carbon black, the carbon black being a conductivity imparting agent, 30 parts by mass low density polyethylene, the low density polyethylene being a high-polymer compound, and 10 parts by mass polyethylene fine powder wax", it can be said that it includes a high-polymer compound of 40% of the total weight of the electron-conductive material.

Furthermore, considering that "porous layer" of Cited invention 2 is one "including" "electron-conductive material", the matter of Cited invention 2 that "the electron-conductive material is prepared by mixing 60 parts by mass carbon black, the carbon black being a conductivity imparting agent, 30 parts by mass low density polyethylene, the low density polyethylene being a high-polymer compound, and 10 parts by mass polyethylene fine powder wax, and has a Curie temperature of about 100 degrees C" and the matter of the Amended Invention that "the PTC material layer includes high-density polyethylene of 40 to 60 weight% of the total weight of a PTC composition, the high-density polyethylene having a density exceeding 0.94 g/cm³" are in common.

(11) "Nonaqueous electrolyte lithium secondary battery" of Cited invention 2 corresponds to "lithium secondary battery" of the Amended Invention.

According to the above-mentioned (1)-(11), the Amended Invention and Cited invention 2 are identical in

"A lithium secondary battery comprising an electrode assembly for a secondary battery, the electrode assembly comprising:

a positive electrode having a positive electrode active material layer formed on a positive electrode collector;

a negative electrode having a negative electrode active material layer formed on a negative electrode collector; and

a polyolefin-based separation film interposed between the positive electrode and the negative electrode,

wherein a PTC (Positive Temperature Coefficient) material layer is formed on a top face of an active material layer of at least either one of the positive electrode and the negative electrode, and the PTC material layer has the same area as that of each active material layer, and

wherein the PTC material layer includes a high-polymer compound of 40 to 60 weight% of the total weight of a PTC composition." The difference between them is as follows.

(The difference)

A high-polymer compound included in "PTC composition" is "high-density polyethylene having a density exceeding 0.94 g/cm³" in the Amended Invention., whereas in Cited invention 2, it is "low density polyethylene" and "polyethylene fine powder wax".

The aforementioned difference will be discussed below.

A Cited Document 1 disclosed that a conductivity imparting agent is added to a high-polymer compound as an electron-conductive material. It says that "this high-polymer material has electron conductivity, and Curie temperature can be adjusted arbitrarily by adjusting molecular weight of the high-polymer compound or by introduction of an additive agent" ([0017]), and, in addition, it is disclosed that "Regarding these high-polymer compounds, it may be the case that only one kind is selected and used, or two kinds or more of them may be used in a combined manner in order to obtain necessary positive temperature characteristic" ([0018]). According to such description, it can be said that it is suggested that Curie temperature of "electron-conductive material" of Cited invention 2 is adjusted accordingly.

B Furthermore, Cited Document 1 says, "electron-conductive material is a high-polymer material to which electron conductivity is given can be used" ([0015]), "As the above-mentioned high-polymer material, a high-polymer compound to which a conductivity imparting agent is added is suitably used" ([0017]), and "The above-mentioned high-polymer compound preferably is a crystalline high-polymer compound, Specifically, high-density polyethylenelow density polyethyleneand the like can be used" ([0018]), and high-density polyethylene is illustrated in parallel with low density polyethylene. Therefore, it can be said that it is suggested that, as "electron-conductive material" of Cited invention 2, high-density polyethylene is used instead of low density polyethylene.

C On the other hand, regarding high-density polyethylene, Cited Document 2 says, "In a lithium secondary battery, in the case of the lithium secondary battery including a positive electrode or a negative electrode having an active material layer including a PTC conducting material, and the PTC conducting material is a complex material containing a conductive filling material and crystalline resin, a temperature of the PTC conducting material at which a PTC characteristic is shown depends on the melting point of the crystalline resin included in the PTC conducting material, and, therefore, the temperature at which the PTC characteristic is shown can be adjusted by changing a kind of crystalline resin, and as crystalline resin, high-density polyethylene (melting point: 130 degrees C to 140 degrees C) can be cited, for example". (Refer to the above-mentioned "No. 2" "4" "(2)" "G")

PTC temperature can be adjusted by changing a type of crystalline resin included in a PTC conducting material and it is known that, if high-density polyethylene, for example, is adopted as crystalline resin, PTC temperature can be 130-140 degrees C.

Meanwhile, the above-mentioned "PTC conducting material" in Cited Document 2 is "complex material containing a conductive filling material and crystalline resin", whereas, "electron-conductive material" of Cited invention 2, "is prepared by mixing 60 parts by mass carbon black, the carbon black being a conductivity imparting agent, 30 parts by mass low density polyethylene, the low density polyethylene being a high-polymer compound, and 10 parts by mass polyethylene fine powder wax". Then, "conductive filling material" and "crystalline resin" of the above-mentioned matter described in Cited Document 2 respectively correspond to "conductivity imparting agent is a carbon black", and "low density polyethylene" and "polyethylene fine powder wax" of Cited invention 2, and, therefore, the above-mentioned "PTC conducting material" of Cited Document 2 corresponds to

"electron-conductive material" of Cited invention 2.

D The "electron-conductive material" of the "nonaqueous electrolyte lithium secondary battery" of the Cited invention 2 has a Curie temperature of about 100 degrees C. Since such a battery is used at various temperatures such as a room temperature to a higher temperature than that, it is normal to set PTC temperature relatively high in order to use a lithium secondary battery at a high temperature.

E According to the above-mentioned A, Cited Document 1 suggests that Curie temperature of "electron-conductive material" of Cited invention 2 is to be adjusted. According to the above-mentioned B, Cited Document 1 suggests that, as "electron-conductive material" of Cited invention 2, high-density polyethylene is used instead of low density polyethylene, according to the above-mentioned C, PTC temperature can be adjusted by changing a kind of crystalline resin included in a PTC conducting material, and PTC temperature can be made to be 130-140 degrees C by employing high-density polyethylene as crystalline resin. Thus, it could have been achieved easily by a person skilled in the art that "nonaqueous electrolyte lithium secondary battery" of Cited invention 2 includes "high-density polyethylene" with a melting point of "130 degrees C to 140 degrees C" as shown in Cited Document 2 instead of "low density polyethylene" and "polyethylene fine powder wax" that "has a Curie temperature of about 100 degrees C" in order to make it have suitable PTC temperature as a battery used in a higher temperature environment.

F Then, it is the common general technical knowledge that high-density polyethylene has a density exceeding 0.94 g/cm^3 ("Iwanami Rikagaku Jiten", ninth printing of fourth edition, IWANAMI SHOTEN, issued on Jul. 18, 1994, page 1234, "Polyethylene" Section), and thus it is obvious that "high-density polyethylene" of the above-mentioned matter described in Cited Document 2 also has a density exceeding 0.94 g/cm^3 .

Accordingly, it could have been achieved easily by a person skilled in the art to let Cited invention 2 have the matter specifying the Amended Invention, which the difference relates to.

In addition, it is recognized that an effect provided by the Amended Invention is of a degree that can be predicted by a person skilled in the art from the matters described in the Cited inventions, Cited Documents 1, 2, and, the common general technical knowledge.

Accordingly, the Amended Invention could have been easily invented by a person skilled in the art based on the Cited inventions, the matters described in Cited Documents 1, 2, and the common general technical knowledge, and, therefore, the appellant should not be granted a patent for it independently at the time of patent application under the provisions of Article 29(2) of the Patent Act.

6 Closing remarks as to the decision to decline the amendment

As mentioned above, the Amendment of the case violates the provisions of Article 126(7) of the Patent Act as applied mutatis mutandis pursuant to the provisions of Article 17-2(6) of the same Act, and thus should be dismissed under the provisions of

Article 53(1) of the same Act which is applied mutatis mutandis pursuant to Article 159(1) of the same Act.

No. 3 Regarding the invention of the case

1 The Invention of the case

Since the amendment dated May 26, 2015 has been dismissed as mentioned in the above "No. 2", the Invention according to claim 6 that refers to claim 1 of the scope of claims of the present application (hereinafter, referred to as "the Invention") is described as claim 1 and claim 6 of the scope of claims that was amended by the written amendment dated Oct. 30, 2014, and is rewritten as follows by dissolving the citation relation.

"A lithium secondary battery comprising an electrode assembly for a secondary battery, the electrode assembly comprising:

a positive electrode having a positive electrode active material layer formed on a positive electrode collector;

a negative electrode having a negative electrode active material layer formed on a negative electrode collector; and

a polyolefin-based separation film interposed between the positive electrode and the negative electrode,

wherein a PTC (Positive Temperature Coefficient) material layer is formed on a top face of an active material layer of at least either one of the positive electrode and the negative electrode, and the PTC material layer has the same area as that of each active material layer."

2 Reason of the Examiner's decision

One of the reasons stated in the examiner's decision for refusal is that they fall under Article 29-1(3) of the Patent Act and the appellant should not be granted a patent since the inventions according to claim 1 to 9 are identical to the inventions disclosed in Cited Document 1.

3 Cited publications

Cited Document 1 was cited in the reasons stated in the examiner's decision for refusal and it was distributed before the priority date for the application. What is disclosed in the Cited Document 1 and Cited invention 2 are stated in the above-mentioned "No. 2" "4" "(1)" and "(1-2)", respectively.

4 Comparison and Judgment by the body

When the Invention is compared with Cited invention 2, the Invention is obtained by eliminating the structure "the PTC material layer includes high-density polyethylene of 40 to 60 weight% of the total weight of a PTC composition, the high-density polyethylene having a density exceeding 0.94 g/cm³" according to the Amended Invention, and, thus, in light of "(1)" to "(11)" of the above-mentioned "No. 2" "5" "5-2" , the Invention is entirely identical to the Cited invention 2 and there is no difference between them.

Accordingly, the Invention is Cited invention 2.

5 Closing remarks

As mentioned above, since the Invention is identical to the inventions disclosed in Cited Document 1, the appellant should not be granted a patent for it under the provisions of Article 29-1(3) of the Patent Act.

The application should be rejected without examining inventions according to the other claims.

Accordingly, the decision shall be made as described in the conclusion.

September 27, 2016

Chief administrative judge: ITAYA, Kazuhiro
Administrative judge: TSUCHIYA, Tomohisa
Administrative judge: IKEFUCHI, Ryu