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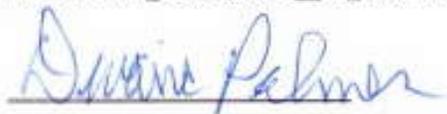
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The attached Japanese into English translation has been translated by me and to the best of my knowledge and belief, it is a true and accurate translation of JP2003031266A.

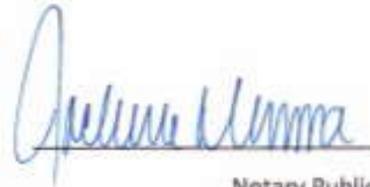
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Executed on June 1, 2021 in Orem Utah.



(Affiant's Name)



Notary Public

Sept 09 2024
Notary Commission Expiry

(19) Japanese Patent Office (JP)

(12) Publication of Unexamined Patent Application (A)

(11) Patent Application Disclosure
2003-31266

(P2003-31266A)

(43) Publication Date: January 31, 2003

(51) Int. Cl. ⁷	ID Number	FI		Theme code (ref.)
H01M 10/40		H01M	10/40	Z 5H017
4/78			4/78	A 5H029

Request for Examination: Not Requested Number of Claims: 1 OL (Total pages: 7)

(21) Application No.: 2001-215825 (P2001-215825)

(22) Application Date: July 16, 2001

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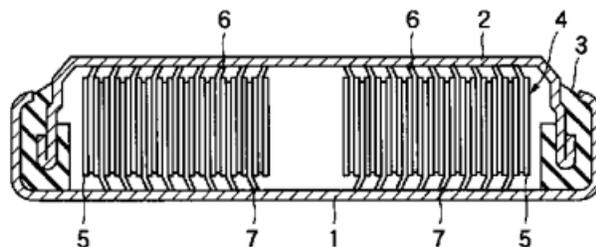
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(54) [Title of the Invention] FLAT-TYPE NON-AQUEOUS SECONDARY BATTERY

(57) [Abstract]

[Purpose] The purpose is to provide a flat-type non-aqueous secondary battery with improved discharge capacity.

[Resolution Means] A flat-type non-aqueous secondary battery having a sealed container obtained by crimping and fixing a positive electrode container 1 and a negative electrode container 2 through an insulating gasket 3, and an electrode group 4 which is stored in the sealed container and is composed of a spirally rolled laminated member having a positive electrode including a positive electrode current collector and a negative electrode including a negative electrode current collector, wherein an end part of the positive electrode current collector or the negative electrode current collector is made to protrude from one of the roll surfaces electrode group, and the protruding end part is bent to contact the inner surface of the positive electrode container or the negative electrode container having the same electrode as the protruding end part.



[Scope of Patent Claims]

What Is Claimed Is:

[Claim 1] A flat-type non-aqueous secondary battery having a sealed container obtained by crimping and fixing a positive electrode container and a negative electrode container through an insulating gasket, and an electrode group which is stored in the sealed container and is composed of a spirally rolled laminated member having a positive electrode including a positive electrode current collector and a negative electrode including a negative electrode current collector;

wherein an end part of the positive electrode current collector or the negative electrode current collector is made to protrude from one of the roll surfaces electrode group, and the protruding end part is bent to contact the inner surface of the positive electrode container or the negative electrode container having the same electrode as the protruding end part.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a flat-type non-aqueous secondary battery.

[0002]

[Background Technology] The main application of small non-aqueous electrolyte batteries such as coin or button type non-aqueous electrolyte batteries has been as a main power source for small devices and a backup power source for recording elements. All cases consume very little power and are intended for long-term use. The structure is known to include a metal positive electrode case containing a pellet-shaped positive electrode and a metal negative electrode case containing a pellet-shaped negative electrode, with a separator interposed between the positive and negative electrodes. With this structure, the reactivity is low due to the small reaction area between the positive and negative electrodes, and only a small current can be discharged.

[0003] On the other hand, cylindrical and rectangular batteries used in mobile phones and electronic devices are capable of discharging at high currents because they use a group of electrodes rolled in a spiral shape with a separator interposed between the band-shaped positive and negative electrodes. In addition, there is a degree of freedom in designing the thickness and area of the electrode to match the load and capacity of the required electronic device.

[0004] Incidentally, there is a need for coin- or button-type non-aqueous electrolyte batteries to carry a large current due to the diversification of their uses. In order to carry a large current, the reaction area of the electrodes must be large, and a rolled structure is required, like a cylindrical or square battery. There is a method of storing thin, square electrodes by crushing rolled structure electrodes in a flat container used for coin or button type batteries (e.g., Japanese Unexamined Patent Application 2000-164259), but storing a square electrode group in a cylindrical container causes a problem in that a lot of space is wasted. However, storing a square electrode group in a cylindrical container causes a problem in that a lot of wasted space is generated.

[0005] In order to solve such a problem, Japanese Unexamined Patent Application H11-345626 proposes making the height in the direction of the central axis of the roll smaller than the size in the direction perpendicular to the central axis.

[0006] However, in the battery described in Japanese Unexamined Patent Application H11-345626, high discharge capacity cannot be obtained because the electrical connection is made by contact between the tab and the container.

[0007]

[Problem to be Solved by the Invention] An object of the present invention is to provide a flat-type non-aqueous secondary battery with improved discharge capacity.

[0008]

[Means for Solving the Problem] The flat-type non-aqueous secondary battery of the present invention has a sealed container obtained by crimping and fixing a positive electrode container and a negative electrode container through an insulating gasket, and an electrode group which is stored in the sealed container and is composed of a spirally rolled laminated member having a positive electrode including a positive electrode current collector and a negative electrode including a negative electrode current collector, wherein an end part of the positive electrode current collector or the negative electrode current collector is made to protrude from one of the roll surfaces electrode group, and the protruding end part is bent to contact the inner surface of the positive electrode container or the negative electrode container having the same electrode as the protruding end part.

[0009]

[Description of the Preferred Embodiments] An example of a flat-type non-aqueous secondary battery is described.

[0010] This flat-type non-aqueous secondary battery has a sealed container obtained by crimping and fixing a positive electrode container and a negative electrode container through an insulating gasket, and an electrode group which is stored in the sealed container and is composed of a spirally rolled laminated member having a positive electrode including a positive electrode current collector and a negative electrode including a negative electrode current collector. A separator can be provided between the positive and negative electrodes.

[0011] The flat non-aqueous secondary battery can have the structure described in (a) to (c) below.

[0012] (a) The end part of the positive electrode current collector is made to protrude from one roll surface of the electrode group, and the protruding end part is bent to contact the inner surface of the positive electrode container.

[0013] (b) The end part of the negative electrode current collector is made to protrude from one roll surface of the electrode group, and the protruding end part is bent to contact the inner surface of the negative electrode container.

[0014] (c) The end part of the positive electrode current collector is made to protrude from one roll surface of the electrode group, and the protruding end part is bent to contact the inner surface of the positive electrode container. Furthermore, the end part of the negative electrode current collector is made to protrude from a second roll surface of the electrode group, and the protruding end part is bent to contact the inner surface of the negative electrode container.

[0015] Herein, the roll surface refers to the surface perpendicular to the roll axis of the electrode group.

[0016] Of the aforementioned configurations (a) to (c), the discharge capacity of configuration (c) can be significantly enhanced, which is desirable.

[0017] With the aforementioned configurations (a) to (c), the edge part of the negative electrode active material-containing layer preferably protrudes from the edge of the positive electrode active material-containing layer. This is because lithium dendrites tend to precipitate at the edge of the negative electrode active material-containing layer when the edge part of the negative electrode active material-containing layer is facing the positive electrode active material-containing layer.

[0018] With the aforementioned configurations (a) to (c), the end parts protruding from the roll surface can be bent to the outer or inner circumference of the electrode group. Bending to the inner circumference is preferred because it is less likely to cause an internal short circuit.

[0019] In the electrode group, the length in the direction perpendicular to the roll axis is preferably longer than the length in the roll axis direction. Using this configuration, a non-aqueous electrolyte battery with a thin profile and high energy density can be obtained.

[0020] The positive electrode, negative electrode, separator and non-aqueous electrolyte are described below.

[0021] (1) Positive Electrode

The positive electrode is formed from a positive electrode layer containing an active material and a conductive material, supported on a current collector.

[0022] The active material can be various oxides (for example, lithium manganese complex oxides such as LiMn_2O_4 , manganese dioxide, lithium nickel complex oxide such as LiNiO_2 , lithium cobalt complex oxides such as LiCoO_2 , lithium cobalt nickel complex oxide, lithium containing amorphous vanadium pentoxide, and the like) or chalcogen compounds (for example, titanium disulfide, molybdenum disulfide, etc.). Of these, lithium manganese composite oxides, lithium cobalt composite oxides and lithium nickel composite oxides are preferably used.

[0023] For example, aluminum expanded metal, aluminum foil, aluminum mesh, aluminum punched metal, and the like can be used as the current collector.

[0024] Examples of the conductive material (conductive filler) include carbon black (for example, acetylene black, furnace black, ketjen black, and the like), graphites (for example, artificial graphite, powdered graphite, powdered expanded graphite, and the like), pulverized glassy carbon, powdered or crushed coke, carbon fiber pulverized material, graphitized carbon fiber pulverized material, nickel powder, and the like. The aforementioned conductive materials may be used alone, or two or more materials may be blended and used together.

[0025] The positive electrode is made, for example, by preparing a slurry by kneading a positive electrode active material, a conductive material, and a binder in the presence of a solvent, applying the slurry to a current collector, drying, and then press forming.

[0026] The binding agent may be, for example, polyvinylidene fluoride, styrene butadiene copolymer, carboxymethyl cellulose, derivatives thereof, and the like.

[0027] (2) Negative Electrode

The negative electrode is formed from a negative electrode layer containing an active material supported on a current collector.

[0028] The active material can be, for example, a carbonaceous material that absorbs and releases lithium

ions. Examples of the carbonaceous material include materials obtained by calcination of organic polymer compounds (for example, phenol resin, polyacrylonitrile, cellulose, and the like), coke, materials obtained by calcination of mesophase pitch, artificial graphite, natural graphite, and the like. Of these, a carbonaceous material obtained by calcinating mesophase pitch at a temperature of 500-3000°C under normal or reduced pressure in an inert gas atmosphere such as argon gas or nitrogen gas is preferably used.

[0029] Examples of the current collector can include copper expanded metal, copper foil, copper mesh, copper punched metal, and the like.

[0030] The negative electrode is allowed to contain a conductive material (conductive filler). The conductive material (conductive filler) can be the same materials as described for the positive electrode.

[0031] The negative electrode is made, for example, by preparing a slurry by kneading a negative electrode active material and a binder, in the presence of a solvent, applying the slurry to a current collector, drying, and then press forming.

[0032] The binder can be the same as the aforementioned binder described for the positive electrode.

[0033] (3) Separator

The separator can be any type of separator that allows the movement of lithium ions while isolating the positive and negative electrodes. These separators can be, for example, microporous membranes and non-woven fabrics mainly composed of polyolefins (for example, polyethylene, polypropylene).

[0034] (4) Non-aqueous Electrolyte

The non-aqueous electrolyte is prepared, for example, by dissolving an electrolyte in a non-aqueous solvent.

[0035] Examples of the non-aqueous solvent can be ethylene carbonate (EC), propylene carbonate (PC), butylene carbonate (BC), dimethyl carbonate (DMC), diethyl carbonate (DEC), ethyl methyl carbonate (EMC), γ -butyrolactone (γ -BL), sulfolane, acetonitrile, 1,2-dimethoxyethane, 1,3-dimethoxypropane, dimethyl ether, tetrahydrofuran (THF), 2-methyltetrahydrofuran, and the like. The aforementioned non-aqueous solvents may be used alone or in a mixture of two or more types.

[0036] Examples of the electrolyte include lithium salts such as lithium perchlorate (LiClO_4), lithium hexafluorophosphate (LiPF_6), lithium borofluoride (LiBF_4), lithium arsenic hexafluoride (LiAsF_6), lithium trifluoromethanesulfonate (LiCF_3SO_3), and the like. The electrolytes may be used alone or in a mixture of two or more types.

[0037] The dissolution amount of the electrolyte in the non-aqueous medium should be in the range of 0.2 mol/L to 2 mol/L.

[0038] An example of a flat-type non-aqueous secondary battery is illustrated in FIGS. 1-5. FIG. 1 is a cross-sectional view of an example of a flat-type non-aqueous secondary battery (for example, a coin-type non-aqueous secondary battery).

[0039] An electrode group 4 is stored in a sealed container in which a cylindrical positive electrode container with bottom (outer can) 1 is crimped and fixed to a cylindrical negative electrode container with bottom (cap) 2 via an insulating gasket 3. The electrode group 4 is fabricated, for example, by being rolled in a spiral shape with a separator 5 interposed between the positive electrode and the negative electrode. a negative electrode current collector 6 protrudes from one roll surface of the electrode group 4, and the protruding negative electrode current collector 6 is bent to the inner circumference and contacts the inner surface of the negative electrode container 2. Furthermore, the positive electrode current collector 7 protrudes from the second roll surface of the electrode group 4, and the protruding positive electrode current collector 7 is bent to the inner circumference and contacts the inner surface of the positive electrode container 1. The non-aqueous electrolyte is impregnated in the electrode group 4.

[0040] This flat-type non-aqueous secondary battery of the present invention described above has a sealed container obtained by crimping and fixing a positive electrode container and a negative electrode container via an insulating gasket, and an electrode group which is stored in the sealed container and is composed of a spirally rolled laminated member having a positive electrode including a positive electrode current collector and a negative electrode including a negative electrode current collector. An end part of the positive electrode current collector or the negative electrode current collector is made to protrude from one of the roll surfaces electrode group, and the protruding end part is bent to contact the inner surface of the positive electrode container or the negative electrode container having the same electrode as the protruding end part.

[0041] If the length of the electrode group in the direction perpendicular to the roll axis is made longer than the length in the roll axis direction in order to increase the energy density of the flat battery, the electrode group is easily deformed into a telescoping roll shape by handling or the like during manufacturing, resulting in roll shifting and disintegration. According to the present application, even when the length in the direction perpendicular to the roll axis is longer than the length in the direction of the roll axis of the electrode group, the electrodes and separator near the center of the roll surface can be restrained from protruding outward by the bent part, thereby reducing roll shifting and disintegration of the electrode group during manufacturing.

[0042] In addition, the edge protruding from the roll surface is bent without a notch, so a repulsive force that attempts to return the bent part to the original shape can easily act, and thus the contact area between the protruding edge and the inner surface of the container can be improved. As a result, the internal resistance of the battery can be reduced and the discharge capacity can be enhanced.

[0043]

[Examples] An example of the present invention will be described below in detail while referring to the drawings.

[0044] FIG. 2 is a plan view illustrating the positional relationship between the positive electrode, the negative electrode, and the separator of the electrode group in the coin-type non-aqueous

secondary battery of FIG. 1; FIG. 3 is a cross-sectional view along line III-III of FIG. 2; FIG. 4 is a schematic view illustrating a rolled body in which the positive electrode, the separator and the negative electrode of FIG. 2 are rolled in a spiral shape; and FIG. 5 is a cross-sectional view illustrating a state in which the negative electrode collector protruding from one roll surface of the rolled body of FIG. 4 is bent to the inner circumference.

[0045] (Example 1)

Preparation of the Positive Electrode: The positive electrode slurry was prepared by dissolving 3 parts by mass of polyvinylidene fluoride (product name: #1100 manufactured by Kureha Chemical Industry) in 25 parts by mass of N-methylpyrrolidone, then adding 89 parts by mass of LiCoO₂ with an average particle diameter of 3 μm as a positive electrode active material and 8 parts by mass of graphite (product name: KS6 manufactured by Lonza) as a conductive material, then stirring and mixing using a dissolver and a bead mill. The slurry was applied to both sides of 15 μm thick aluminum foil as a current collector at regular intervals using a die coater, dried, pressed, and slit to obtain a reel-shaped positive electrode 9 having a width of 3.5 mm and having the structure illustrated in FIG. 2, with a thickness of 200 μm, a width of the positive electrode active material-containing layer 8 of 2 mm, and a width of the positive electrode active material-containing layer non-retaining region 7 (positive electrode current collector) of 1.5 mm.

[0046] Preparation of the Negative Electrode: 10 mass parts of graphite powder (product name: KS15 manufactured by Lonza) were added and mixed into 100 mass parts of mesophase pitch-based carbon fiber powder (manufactured by Petca), and then 4.2 mass parts of styrene/butadiene latex (product name: L1571 manufactured by Asahi Kasei Corporation, solid content 48% by weight), 130 mass parts of an aqueous solution (solid content 1% by weight) of carboxymethyl cellulose (product name: BSH12 manufactured by Dai-ichi Kogyo Seiyaku) as a thickener, and 20 mass parts of distilled water were added and mixed to prepare a slurry. The slurry was applied to both sides of a 10 μm thick copper foil at regular intervals using a die coater, dried, pressed, and slit to obtain a reel-shaped negative electrode 11 with a width of 4.5 mm and having the structure illustrated in FIG. 2, a thickness of 200 μm, a width of the negative electrode active material-containing layer 10 of 3 mm, and a width of the negative electrode active material-containing layer non-retaining region 6 (negative electrode current collector) of 1.5 mm.

[0047] Preparation of the Electrode Group: A 4 mm wide strip of a porous polyethylene film was prepared as the separator 5. The active material-containing layer 8 of the positive electrode 9 was made to face the central portion of the active material-containing layer 10 of the negative electrode 11, the separator 5 was placed on the outer side of the positive electrode 9 between the negative electrode 11 and the positive electrode 9 so that the end part of the negative electrode current collector 6 protruded from one end of the long side of the separator 5, and the end of the positive electrode current collector 7 protruded from the second end. The laminated member that was obtained was rolled in a spiral shape, and as illustrated in FIG. 4, the roll end portion of the obtained rolled body 12 was secured with adhesive tape 13.

[0048] Next, as illustrated in FIG. 5, the negative electrode current collector 6 protruding from one roll surface of the rolled body 12 was bent down to the inner circumference every 90° such that the entire body was bent. Furthermore, the positive electrode current collector 7 protruding from the second roll surface of the roll body 12 was bent to the inner circumference at 90° intervals

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