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**LEAD ACID****5762654****METHOD FOR MAKING LEAD-ACID  
GRIDS AND CELLS AND BATTERIES  
USING SUCH GRIDS**

Kump William H; Batson Rosalind St Paul, MN, UNITED STATES assigned to GNB Technologies Inc

A continuous process for making lead-acid grids and plates for a family of cells and batteries requiring grids with a particular plate width and varying plate heights comprises expanding and slitting a continuous strip to provide the desired width and a grid having at least one side frame bar and an interconnected expanded mesh, pasting the expanded mesh with active material, determining the grid height desired and then cutting the expanded mesh strip transversely of the direction of travel to provide plates of the desired height while forming a plate lug from one side frame bar.

**5766303****PROCESS FOR THE REMEDIATION OF  
LEAD-CONTAMINATED SOIL AND  
WASTE BATTERY CASINGS**

Bitler John A; Baranski John P Denver, PA, UNITED STATES assigned to Exide Corporation

Lead-contaminated soil and battery casings are remediated using a plasma arc furnace which pyrolyzes the soil and waste battery casings so as to form a vitrified slag and a combustible gas, respectively. The combustible gas along with volatilized lead (and other heavy metals which may be present) are transferred to, and used as a primary fuel by, a conventional smelting furnace. The volatilized lead that is entrained in the combustible gas is thus transferred to the recovery and environmental protection/control equipment associated with the smelting furnace or other conversion system. The soil, on the other hand, is converted into a non-toxic (i.e., according to the Toxicity Characteristic Leaching Procedure) vitrified slag by the plasma arc which may be crushed and used as a commercial material (e.g., roadway aggregate, asphalt filler material and the like) or simply transferred to a landfill where it poses no environmental threat.

**5780183****AGENT FOR MAINTAINING AND  
RECOVERING THE FUNCTION OF LEAD  
STORAGE BATTERY AND  
ELECTROLYTE FOR LEAD STORAGE  
BATTERY USING THE SAME**

Komoda Katsuichi Toyonaka, JAPAN assigned to Kyowa Hakko Kogyo Co Ltd; K-TEC Co Ltd

The present invention relates to an agent for maintaining and recovering the function of a lead storage battery, comprising as active ingredients a metal sulfate and at least one of an amino acid and a salt thereof, as well as an electrolyte for use in a lead storage battery comprising the above agent and a basal electrolyte. According to the present invention, there is provided a highly effective agent or electrolyte for maintaining the function of a lead storage battery over a long period and recovering the function of a lead storage battery whose storage capacity has been lowered.

**5788739****PROCESS FOR RECOVERING METALLIC  
LEAD FROM EXHAUSTED BATTERIES**

Margulis Efim Haifa, ISRAEL assigned to Margulead Ltd

The present invention relates to a process for the recovery of metallic lead from exhausted lead-acid batteries. According to the invention, the metallic scrap obtained thereof is treated by a smelting operation which is carried out under a layer of a molten flux. The flux comprises alkali hydroxide and optionally also carbonate(s) and sulfate(s) of said alkali. The temperature which is maintained during the smelting is between 350°C to 600°C and most preferably in the range of between 450°C to 550°C The preferred weight ratio between the metallic scrap and the flux is between 15 to 45. Generally, the alkali flux is selected from sodium hydroxide and potassium hydroxide and mixtures thereof. The process is characterized by a very extent of lead recovery compared with the known processes and absence of exhausted gases.

**5789103**  
**BATTERY SEPARATOR AND METHOD**  
**OF MAKING**

Young James; Alexander Francis; Weerts Daniel  
 Sunriver, OR, UNITED STATES assigned to AMTEK  
 Research International LLC

A battery separator for use in flooded cell type lead acid batteries comprising a backweb of a porous, acid resistant, embossable material with a plurality of major ribs and submini-ribs extending from at least one planar surface of the backweb. The ribs are located across the width of the backweb and extend in a direction substantially parallel to the longitudinal edges of the backweb. Each major rib overlies at least one submini-rib and is an embossed corrugated structure comprised of alternating ridges and furrows. The ridges and furrows are in non-parallel alignment to the longitudinal dimension of the separator, and preferably perpendicular thereto. The major ribs are formed on a battery separator backweb having a plurality of submini-ribs extending from at least one planar surface thereof by passing the backweb through the nip formed by a pair of opposed embossing rollers and embossing the backweb in the area of at least one submini-rib.

**FUEL CELL**

**5761793**  
**PROCESS FOR THE PRODUCTION OF A**  
**COMPOSITE CONSISTING OF**  
**ELECTRODE MATERIAL, CATALYST**  
**MATERIAL AND A**  
**SOLID-ELECTROLYTE MEMBRANE**

Bevers Dirk; Wagner Norbert Boeblingen,  
 GERMANY assigned to Deutsche Forschungsanstalt  
 fuer Luft- und Raumfahrt e V

In order to improve a process for the production of a composite consisting of electrode material, catalyst material and a solid-electrolyte membrane for an electrochemical cell, in particular a fuel cell, with which solid-electrolyte material is brought into pore-deep contact with the electrode material and the catalyst material by softening it, such that this can be carried out as effectively and inexpensively as possible it is suggested that a catalytic powder comprising electrode material, catalyst material and the solid-electrolyte

material be produced, that a catalytic layer be produced on a carrier from the catalytic powder, that the catalytic layer be heated on a side facing away from the carrier to soften the solid-electrolyte material and that subsequently the catalytic layer be applied under pressure to the solid-electrolyte membrane while the solid-electrolyte material is still softened in order to form a composite.

**5763113**  
**PEM FUEL CELL MONITORING SYSTEM**

Meltser Mark Alexander; Grot Stephen Andreas  
 Pittsford, NY, UNITED STATES assigned to General  
 Motors Corporation

Method and apparatus for monitoring the performance of H<sub>2</sub>-O<sub>2</sub> PEM fuel cells. Outputs from a cell/stack voltage monitor and a cathode exhaust gas H<sub>2</sub> sensor are corrected for stack operating conditions, and then compared to predetermined levels of acceptability. If certain unacceptable conditions coexist, an operator is alerted and/or corrective measures are automatically undertaken.

**5763114**  
**INTEGRATED REFORMER/CPN SOFC**  
**STACK MODULE DESIGN**

Khandkar Ashok C; Elangovan Singaravelu Salt Lake  
 City, UT, UNITED STATES assigned to Gas Research  
 Institute

A thermally integrated reformer is located inside the stack furnace housing stacks of solid oxide fuel cells. The energy to support the endothermic reformation reaction converting hydrocarbon and water feedstock into hydrogen and carbon monoxide fuel is supplied by heat recovered from the oxidation process in the stack of fuel cells. The source of hydrocarbons is desulfurized natural gas. Heat transfers to reformers which may be incrementally shielded packed beds of the reactors of the reformer by radiation from the stacks, furnace wall, or both and by forced convection from the exhausting airflow exiting the stack furnace. Temperature gradients in the reformer may be controlled by selective (or incremented) radiation shielding and by counterflow heat exchange to prevent excessive premature cracking in the reformer. Such an optimized design uses a minimum amount of catalyst, yet prevents carbonization from clogging interstices or otherwise rendering the

catalyst or catalyst granules ineffective. Alternatively sufficient catalyst may be provided to render the reformation process a heat-limited reaction. In this circumstance, the stacks configured in a module may transfer heat directly to a reformer surrounding the module. The air may pass through a heat exchanger or preheater positioned proximate the module in an insulated enclosure.

**5770327**

**SOLID OXIDE FUEL CELL STACK**

Barnett Scott Alexander; Tsai Tsepin Evanston, IL, UNITED STATES assigned to Northwestern University

A solid oxide fuel cell stack having metal interconnects with fuel and oxidant distribution cavities formed by bonding together three stainless steel sheets.

**5763765**

**METHOD AND APPARATUS FOR  
DETECTING AND LOCATING  
PERFORATIONS IN MEMBRANES  
EMPLOYED IN ELECTROCHEMICAL  
CELLS**

Lamont Gordon; Wilkinson David P New Westminster, CANADA assigned to Ballard Power Systems Inc

A method and apparatus detects and locates perforations in membranes used in electrochemical cells. The membrane has first and second oppositely facing major planar surfaces. The first surface is exposed to a first reactant fluid, preferably a gaseous mixture comprising hydrogen, while the second surface is exposed to a second reactant fluid, preferably ambient air comprising oxygen. The first and second reactant fluids are substantially fluidly isolated from each other by the membrane when no perforations are present in the membrane. The first reactant fluid contacts the second reactant fluid when at least one perforation is present in the membrane. The first and second reactant fluids exothermically react upon contact, preferably in the presence of a catalyst, to generate heat, which is then detected using an infrared thermal detector or thermal imaging device or a layer of thermally sensitive film positioned in proximity with the membrane.

**5766788**

**ELECTRODE COMPOSITION MATERIAL  
FOR POLYMER ELECTROLYTE FUEL  
CELL AND PROCESS OF PREPARING  
SAME**

Inoue Masahiko; Tada Tomoyuki Kanagawa, JAPAN assigned to Tanaka Kikinzoku Kogyo K K

Disclosed herein are electrode composition material for a polymer electrolyte fuel cell and a process of preparing same. The electrode composition material includes agglomerates composed of catalyst-loading particles coated with or not coated with ion exchange resin having two particle distribution peaks. The electrode composition material having the two particle distribution peaks supplements the drawbacks of excessively fine particles and of excessively coarse particles and can obtain the excellent cell performance.

**5780179**

**FUEL CELL SYSTEM FOR USE ON  
MOBILE BODIES**

Okamoto Takafumi Wako, JAPAN assigned to Honda Giken Kogyo Kabushiki Kaisha

A fuel cell system has a reformer, a water tank for supplying water to humidify a hydrogen gas and an oxidizing gas which has been reformed by the reformer, a fuel cell for being supplied with the humidified hydrogen gas, and first and second gas-liquid separators for separating substances discharged from the fuel cell into gases and water, and supplying the separated water to the water tank. The fuel cell system needs no water supply from an external source and can continuously supply the water from the water tank to the fuel cell.

**5783324**

**FUEL CELL INCLUDING A SINGLE  
SHEET OF A POLYMER ELECTROLYTE  
MEMBRANE (PEM), THE PEM BEING  
DIVIDED INTO REGIONS OF VARYING  
ELECTRICAL AND IONIC  
CONDUCTIVITY**

Binder Michael; Gilman Sol; Mammone Robert J Brooklyn, NY, UNITED STATES assigned to The United States of America as represented by the Secretary of the Army

A fuel cell is provided including a single sheet film or ribbon of any length of a Polymer Electrolyte Membrane ( PEM ) wherein the PEM is divided into regions or zones of varying electrical conductivity and ionic conductivity, allowing the elimination of endplates and/or a bipolar configuration. In this non bipolar arrangement, means are provided for distributing fuel to only one side of the PEM and oxidant to only the other side of the PEM so as to prevent mixing of the fuel and oxidant.

**5783325**

**GAS DIFFUSION ELECTRODES BASED  
ON POLY(VINYLDENE FLUORIDE)  
CARBON BLENDS**

Cabasso Israel; Yuan Youxin; Xu Xiao Syracuse, NY, UNITED STATES assigned to The Research Foundation of State of New York

All electrocatalytic gas diffusion electrode for fuel cells and a process for its preparation is disclosed. The electrode comprises an anisotropic gas diffusion layer and a catalytic layer. The gas diffusion layer is made of a porous carbon matrix through which carbon particles and poly(vinylidene) fluoride are distributed so that the matrix is homogeneously porous in a direction lateral to gas flow and asymmetrically porous to gases in the direction of the gas flow. The porosity of the gas diffusion layer decreases in the direction of gas flow. The catalytic layer is made of a coagulated ink suspension containing catalytic carbon particles and a thermoplastic polymer selected from polyethersulfone, poly(vinylidene fluoride) and sulfonated polysulfone and covers the small pore surface of the gas diffusion layer. The gas diffusion layer has a thickness between 50  $\mu\text{m}$  and 300  $\mu\text{m}$ . The catalytic layer has thickness between 7  $\mu\text{m}$  and 50  $\mu\text{m}$  and a metal catalyst loading between 0.2  $\text{mg}/\text{cm}^2$  and 0.5  $\text{mg}/\text{cm}^2$ .

**5786104**

**METHOD AND APPARATUS FOR  
HUMIDIFICATION OF INCOMING FUEL  
CELL PROCESS GASES**

Black Lance L; Plowman Keith R Richwood, TX, UNITED STATES assigned to The Dow Chemical Company

A fuel gas and an oxidant gas are humidified using a flow transmitter and a static mixer to achieve saturation of fuel and oxidant process gases prior to feeding to a fuel cell.

**5786105**

**SOLID OXIDE FUEL CELL**

Matsushima Toshio; Ikeda Daisuke; Kanagawa Himeko Sayama, JAPAN assigned to Nippon Telegraph and Telephone Public Corporation

A solid oxide fuel cell which includes a substrate having therein a plurality of gas supply passages and a plurality of gas return passages. The gas supply passages have inlet ports on a surface of the substrate and the gas return passages have outlet ports on the same surface of the substrate. A header is interposed between the gas supply and gas return passages so that gas enters the header from the gas supply passages and then enters the gas return passages. The flow rate of the gas in the gas supply passages is less than the flow rate of the gas in the gas return passages. A solid electrolyte is formed on a first surface of the substrate, an electrode is formed on the solid electrolyte, and an interconnector is formed on a second surface of the substrate.

**5788788**

**PREPARATION OF A SOLID OXIDE FUEL  
CELL HAVING THIN ELECTROLYTE  
AND INTERCONNECT LAYERS**

Minh Nguyen Q Fountain Valley, CA, UNITED STATES assigned to AlliedSignal Inc

A method of preparing a fuel cell element includes the steps of: laminating ceramic tapes to form an unfired anode/electrolyte laminate; reducing the thickness of the anode/electrolyte laminate; sintering the anode/electrolyte laminate; laminating ceramic tapes to form an unfired cathode/interconnect laminate; reducing the thickness of the cathode/interconnect laminate; embossing a gas flow path pattern into the cathode layer of the cathode/interconnect laminate; sintering the cathode/interconnect laminate; and bonding the sintered anode/electrolyte laminate to the sintered cathode/interconnect laminate such that the electrolyte layer contacts the cathode layer. The fuel cell produced by this method has thin electrolyte and interconnect layers which result in high fuel cell outlet power.

**5789091****ELECTROCHEMICAL FUEL CELL  
STACK WITH COMPRESSION BANDS**

Wozniczka Boguslaw; Fletcher Nicholas J; Gibb Peter R Coquitlam, CANADA assigned to Ballard Power Systems Inc

An electrochemical fuel cell stack includes a plurality of fuel cell assemblies interposed between a pair of end plate assemblies. The mechanism for securing the stack in its compressed, assembled state includes at least one compression band which circumscribes the end plate assemblies and interposed fuel cell assemblies of the stack. Preferably, at least one of the end plate assemblies comprises a resilient member which cooperates with each compression band to urge the first end plate assembly toward the second end plate assembly, thereby applying compressive force to the fuel cell assemblies to promote sealing and electrical contact between the layers forming the fuel cell stack.

**5789093****LOW PROFILE FUEL CELL**

Malhi Satwinder Garland, TX, UNITED STATES assigned to Texas Instruments Incorporated

A fuel cell stack comprises a plurality of manifolds separated by membranes. Each manifold forms overlapping chambers for adjacent cells such that the depth of chambers for adjacent cells is not additive. In the preferred embodiment, the manifolds are formed of a plastic material with conductive vias formed therethrough to reduce the cost associated with graphite vias.

**5789094****FUEL CELL AND SEALING PARTS  
THEREFORE**

Kusunoki Akira; Otsuki Jitsuji; Kikuoka Yasuhira; Okada Tatsunori; Matsumura Mitsuie; Shinoki Toshio; Mukai Masahiro; Yagi Tetsuya Osaka, JAPAN assigned to Kansai Electric Power Co Inc; Mitsubishi Denki Kabushiki Kais

A bipolar plate is designed to provide a gas seal 16 around an electrode and gas seals 17a around fuel gas

manifolds on the same plane and to separate the gas seal 16 and gas seals 17a around oxidant gas manifolds 4, 6 with hollowed parts on an anode electrode 25 side, and to provide the gas seal 16 and the gas seals 17b on a same plane and to separate the gas seal 16 and the gas seals 17a with hollowed parts on a cathode electrode 20 side. Also disclosed are sealing parts for the fuel side and the oxidant side of the fuel cell.

**5792572****SYSTEM FOR TREATMENT OF ACID  
FUEL CELL FUEL GAS STREAM**

Foley Peter F; Luczak Francis J; Preston John L; Teeling Christopher R; Breault Richard; Fredley Robert; Scheffler Glenn Manchester, CT, UNITED STATES assigned to International Fuel Cells Inc

Ammonia which is found in fuel cell fuel gases is removed therefrom by passing the fuel gas stream through a scrubber bed of porous carbon pellets containing phosphoric acid. The ammonia reacts with the phosphoric acid in the scrubber bed to form ammonium phosphate compounds which remain in the scrubber bed. The ammonia content of the fuel gas stream is thus lowered to a concentration of about one ppm or less. By maintaining the temperature of the fuel gas stream passing through the scrubber bed in a range of about 400 degrees F. to about 450 degrees F. sufficient phosphoric acid will also be evaporated from the scrubber bed to replace acid electrolyte lost during operation of the power plant. Adjustments in the temperature of the fuel gas flowing through the scrubber may be made in order to match electrolyte losses which occur during different operating phases of the power plant. The scrubber formed in accordance with this invention thus serves two functions, one being to remove ammonia from the fuel gas stream, and the other being to replenish electrolyte lost in the power plant during normal operation thereof.

**BATTERY MATERIALS****5762898****GRAPHITE INTERCALATION  
COMPOUND**

Xu BingShe; Tanaka Shun-ichiro Yokohama, JAPAN assigned to Research Development Corporation of Japan; Tanaka Shin-Ichi

An onion-like graphite 2 is produced by irradiating an electron beam to an amorphous carbon 3 under an active aluminum nanoparticle 1. By further irradiating the electron beam to the onion-like graphite 2 to intercalate aluminum atoms constituting the aluminum nanoparticle 1 in a space between (001) plane and (002) plane of the onion-like graphite 2 having a layer structure, an intercalation compound 4 is produced. Or, after the aluminum nanoparticles were driven and disposed on the onion-like graphite by electron beam, or the like, by irradiating the electron beam to intercalate aluminum atoms in the space between the (001) plane and the (002) plane of the onion-like graphite having a layer structure, the intercalation compound is produced.

**5762900**

**CARBON-DOPED LITHIUM MANGANESE OXIDE AND MANUFACTURING METHOD THEREFOR USING POLYETHYLENE GLYCOL**

Kweon Ho-jin; Park Hyu-bum; Kim Keon Suwon, KOREA assigned to Samsung Electronics Co Ltd

Carbon-doped lithium manganese oxides in crystalline powder form can be used as electrode material. The carbon-doped lithium manganese oxide is prepared by a process including the steps of: preparing a first solution of a lithium compound and a manganese compound, said first solution having lithium ions and manganese ions at a mole ratio of 1:2; preparing a solution of polyethylene glycol and adding the polyethylene glycol solution to said first solution to form a second solution and then drying the second solution until a gel is obtained while stirring the second solution; and pre-treating said gel and then heating the pre-treated gel.

**5766569**

**LITHIUM MANGANESE OXIDE COMPOUND AND METHOD OF PREPARATION**

Ellgen Paul C; Andersen Terrell N Oklahoma City, OK, UNITED STATES assigned to Kerr-McGee Chemical Corporation

A method for manufacturing  $\text{Li}_{1+x}\text{Mn}_2\text{O}_4$  comprising the steps of providing  $\text{LiMn}_2\text{O}_4$  or beta- $\text{MnO}_2$ ; providing a source of lithium; dissolving lithium from

the lithium source in a liquid medium in which lithium generates solvated electrons or the reduced form of an electron-transfer catalyst; and contacting the  $\text{LiMn}_2\text{O}_4$  or beta- $\text{MnO}_2$  with the liquid medium containing the dissolved lithium and the solvated electrons or the reduced form of the electron-transfer catalyst.

**5766676**

**METHOD FOR MANUFACTURING RARE EARTH-NICKEL-METALLIC HYDRIDE ELECTRODES**

Park Chung Neun; Choi In Sik Kwangju, KOREA assigned to Gold Star Cable Co Ltd

PCT No. PCT/KR93/00076 Sec. 371 Date Apr. 6, 1995 Sec. 102(e) Date Apr. 6, 1995 PCT Filed Aug. 30, 1993 PCT Pub. No. WO94/06161 PCT Pub. Date Mar. 17, 1994. The present invention relates to a method for manufacturing a nickel-metallic hydride electrode. This invention is characterized in that rare earth-nickel-hydrogen-stored alloy powder is molded by plating it with copper without electrolysis, so that mechanical strength, electric conductivity and reaction velocity can be improved by increasing the amount of plating the surface of a molded electrode with copper.

**5766688**

**PROCESSES INVOLVING METAL HYDRIDES**

Law Henry Hon; Vyas Brijesh Berkeley Heights, NJ, UNITED STATES assigned to Lucent Technologies Inc

Metal hydrides are activated by an electrochemical procedure. In this procedure, a bulk sample of the corresponding metal is immersed in an aqueous electrolyte and contacted by a cathode. Current passed through the aqueous electrolyte causes electrolysis of the water and a concomitant reaction with the formation of metal hydride. As a result, the metal hydride is fractured and smaller particles result. Additionally, the resulting metal hydride has a substantial amount of absorbed hydrogen. A novel plating method, taking advantage of the reducing power of hydrogen absorbed in a metal hydride, is useful to encapsulate such metal hydride with a variety of metals. Therefore, such hydrides are uniformly coated by using plating solutions without the standard reducing agent and stabilizer.



**5766787**  
**SOLID POLYMER ELECTROLYTE**  
**COMPOSITION**

Watanabe Masahiro; Uchida Hiroyuki Yamanashi, JAPAN assigned to Tanaka Kikinzoku Kogyo K K; Masahiro Watana

Disclosed herein is solid polymer electrolyte composition comprising solid polymer electrolyte and at least one metal catalyst selected from the group consisting of platinum, gold, palladium, rhodium, iridium and ruthenium contained in the said solid polymer electrolyte. The said composition may further contain a metal oxide. The membrane made of the composition possesses the abilities of producing water by itself and of retaining the water so that the ionic conductivity and the effect of depressing the crossover is excellent. Accordingly, the cell employing the membrane possesses superior cell performance.

**5766789**  
**ELECTRICAL ENERGY DEVICES**

James David; Allison Daniel B; Kelley John J; Doe James Deal Island, MD, UNITED STATES assigned to Energetics Systems Corporation

The performance of electrochemical energy devices such as batteries, fuel cells, capacitors and sensors is enhanced by the use of electrically conducting ceramic materials in the form of fibers, powder, chips and substrates.

**5766800**  
**HIGHLY HOMOGENEOUS SPINEL**  
**LI<sub>1+X</sub>MN<sub>2</sub>-XO<sub>4</sub>+Y INTERCALATION**  
**COMPOUNDS AND METHOD FOR**  
**PREPARING SAME**

Manev Vesselin; Faulkner Titus Gastonia, NC, UNITED STATES assigned to FMC Corporation

A novel method of preparing a spinel Li<sub>1+X</sub>Mn<sub>2</sub>-XO<sub>4</sub>+Y intercalation compound with low lattice distortion and a highly ordered and homogeneous structure for 4 V secondary lithium and lithium ion cells is provided. The method of preparing the spinel Li<sub>1+X</sub>Mn<sub>2</sub>-XO<sub>4</sub>+Y intercalation compound comprises

providing a spinel Li<sub>1+X</sub>Mn<sub>2</sub>-XO<sub>4</sub> intercalation compound having a lithium to manganese mole ratio of between about 1.02:2 and 1.1:2 and firing the spinel at different temperature ranges with corresponding gas flow rates to form the spinel Li<sub>1+X</sub>Mn<sub>2</sub>-XO<sub>4</sub>+Y intercalation compounds. The spinel Li<sub>1+X</sub>Mn<sub>2</sub>-XO<sub>4</sub>+Y intercalation compounds have a mean X value of between about 0.01 and 0.05, a mean Y value of between about -0.02 and 0.04 and a full width at half maximum of the x-ray diffraction peaks at a diffraction angle 2 theta of planes (400) and (440) using CuK alpha1 rays of between about 0.08 degrees and 0.13 degrees. The spinel Li<sub>1+X</sub>Mn<sub>2</sub>-XO<sub>4</sub>+Y intercalation compounds may be used in the positive electrodes of secondary lithium and lithium ion cells to provide cells having high specific capacities and long cycling lives.

**5770018**  
**METHOD FOR PREPARING LITHIUM**  
**MANGANESE OXIDE COMPOUNDS**

Saidi M Yazi Henderson, NV, UNITED STATES assigned to Valence Technology Inc

The present invention provides a method of preparing an intercalation compound of the nominal general formula Li<sub>x</sub>Mn<sub>2</sub>O<sub>4</sub>, where x is greater than 0 and less than 2, which comprises providing a manganese compound and a lithium compound and mixing such compounds in proportion which provides the desired amount of x demonstrated by the nominal general formula. The mixed compounds are then irradiated with electromagnetic radiation, desirably microwave frequency or infrared radiation whereby manganese, lithium, and oxygen combine to form the Li<sub>x</sub>Mn<sub>2</sub>O<sub>4</sub> having the desired quantity x of lithium. It is desired that the heating by radiation be conducted in air. Preferably, the radiation is microwave radiation and such radiation is at a frequency which causes atomic bonds to vibrate within at least a portion of the precursor compounds and/or the solvent contained in the mixture.

**5770173**  
**METHOD OF PRODUCING CATHODE**  
**ACTIVE MATERIAL FOR NON-AQUEOUS**  
**ELECTROLYTE SECONDARY BATTERY**

Nitta Yoshiaki; Nagayama Masatoshi; Seo Tomoaki Hirakata, JAPAN assigned to Matsushita Electric Industrial Co Ltd

In producing a cathode active material for a non-aqueous electrolyte secondary battery, an hydroxide or an oxyhydroxide of a 3d transition metal, e.g., MnOOH is exposed to an atmosphere of saturated water vapor containing alkali metal ions in a water mist preferably in a pressurized condition, so that the water mist substitutes the alkali metal ions for protons contained in the hydroxide or the oxyhydroxide.

**5770331**

**RADIATION CURABLE FRAME FOR  
STACKED CELL CONSTRUCTION AND  
FOR EDGE SEALING OF ELECTROLYTIC  
CELLS TO RETARD DENDRITIC  
SHORT-CIRCUITS**

Olsen Ib; Moulton Russell D; Chaloner-Gill Benjamin; Buckley James; Golovin Neal; Payne Douglas J San Jose, CA, UNITED STATES assigned to Valence Technology Inc

A new technique for securing into place a plurality of layers which make a battery body, and for preventing electrical short-circuits within the battery by retarding the formation of dendritic growths is disclosed. A radiation curable layer of material is coated onto a portion of at least one outwardly exposed face of a battery body, whereupon the layer of material is then cured. The cured layer of material is positioned relative to the body such that the cured layer provides support to the body in a manner to secure in place a plurality of layers which make up the battery body, thereby ensuring proper electrical contact between the plurality of layers. In addition, the cured layer of material is also positioned such that the cured layer inhibits formation of short circuiting electrical paths between the anode and cathode layers of the battery, the paths being caused by formation of dendritic growths extending out from the anode layer towards the cathode layer.

**5783328**

**METHOD OF TREATING LITHIUM  
MANGANESE OXIDE SPINEL**

Wang Enoch I Mansfield, MA, UNITED STATES assigned to Duracell Inc

A method of treating lithium manganese oxide of spinel structure is disclosed. The method involves heating the

lithium manganese oxide spinel in an atmosphere of an inert gas, e.g, argon, helium, nitrogen or carbon dioxide, which does not react with the spinel. Alternatively, the spinel may be first coated with an alkali metal hydroxide, preferably lithium, sodium or potassium hydroxide and then heated in an atmosphere preferably containing carbon dioxide. Such treatment of lithium manganese oxide spinel improves the performance of the spinel when employed as an electrode in rechargeable cells such as lithium-ion cells. Alternatively, the spinel may be first treated in an aqueous solution of a soluble metal salt of a carboxylic acid prior to treatment with heated carbon dioxide or inert gas. In such latter case the spinel may optionally also be treated with an alkali metal hydroxide prior to treatment with carbon dioxide or inert gas.

**5783333**

**LITHIUM NICKEL COBALT OXIDES FOR  
POSITIVE ELECTRODES**

Mayer Steven T San Leandro, CA, UNITED STATES assigned to PolyStor Corporation

Positive electrodes including a lithium nickel cobalt metal oxide are disclosed. The lithium nickel cobalt metal oxides have the general formula  $\text{Li}_x\text{Ni}_y\text{CO}_z\text{MnO}_2$ , where M is selected from the group consisting of aluminum, titanium, tungsten, chromium, molybdenum, magnesium, tantalum, silicon, and combinations thereof, x is between about 0 and about 1 and can be varied within this range by electrochemical insertion and extraction, the sum of  $y+z+n$  is about 1, n ranges between above 0 to about 0.25, y and z are both greater than 0, and the ratio  $z/y$  ranges from above 0 to about 1/3. Also disclosed are composite positive electrodes including the abovedescribed lithium nickel cobalt metal oxides together with a lithium manganese metal oxide of the formula  $\text{Li}_x\text{Mn}_{2-r}\text{M}_1\text{rO}_4$ , where r is a value between 0 and 1 and M1 is chromium, titanium, tungsten, nickel, cobalt, iron, tin, zinc, zirconium, silicon, or a combination thereof.

**5783334**

**METHOD FOR PRODUCING LITHIUM  
NICKELATE POSITIVE ELECTRODE  
AND LITHIUM BATTERY USING THE  
SAME**

Yasuda Hideo Kyoto, JAPAN assigned to Japan Storage Battery Co Ltd

In a method for producing a lithium nickelate positive electrode, nickel hydroxide or nickel oxyhydroxide is held into an electrically conductive porous substrate to form an electrode plate, the electrode is treated with an alkaline solution containing lithium ion; and the electrode treated with the alkaline solution is heated at a temperature not higher than 450°C

**5788943**

**BATTERY-GRADE NICKEL HYDROXIDE  
AND METHOD FOR ITS PREPARATION**

Aladjov Boyko Cleveland, OH, UNITED STATES  
assigned to The Hall Chemical Company

Nickel hydroxide for use in an electrode of a rechargeable battery is prepared by controlled precipitation from a neutralized reaction mixture of a nickel salt and an alkali metal hydroxide. The controlled precipitation results in the formation of generally spherical particles having a high density. Pulsed or constant ultrasonic energy is applied to the mixture or to a portion thereof during the reaction to cause an alteration in the micro and macrostructures and the surface characteristics of the particles. These alterations result in enhanced performance characteristics of the resultant electrode.

**5789095**

**METHOD OF RECOVERING USEFUL  
MATERIALS FROM SPENT SECONDARY  
BATTERIES FOR ELECTRIC VEHICLES**

Miyagawa Hiroshi; Shirai Ryouichi Ageo, JAPAN  
assigned to Mitsui Mining & Smelting Co Ltd

The method of recovering useful materials from spent secondary batteries for electric vehicles comprises a step of separating spent secondary batteries for electric vehicles into a cover portion and a housing portion, a step of taking out electrode plates to separate them from the housing portion, a step of disassembling electrode plates into positive electrode plates and negative electrode plates, and a step of cutting the pole section so that the positive electrode plates can be separated from the negative electrode plates.

**5789108**

**RECHARGEABLE POSITIVE  
ELECTRODES**

Chu May-Ying Oakland, CA, UNITED STATES  
assigned to PolyPlus Battery Company Inc

Disclosed are positive electrodes containing active-sulfur-based composite electrodes. The cells include active-sulfur, an electronic conductor, and an ionic conductor. These materials are provided in a manner allowing at least about 10% of the active-sulfur to be available for electrochemical reaction. Also disclosed are methods for fabricating active-sulfur-based composite electrodes. The method begins with a step of combining the electrode components in a slurry. Next, the slurry is homogenized such that the electrode components are well mixed and free of agglomerates. Thereafter, before the electrode components have settled or separated to any significant degree, the slurry is coated on a substrate to form a thin film. Finally, the coated film is dried to form the electrode in such a manner that the electrode components do not significantly redistribute.

**5789109**

**CATHODE COMPOSITE**

Nakajima Yasumasa; Izuchi Syuichi; Imachi Hiroshi;  
Fukutome Hiroyuki Takatsuki, JAPAN assigned to  
Yuasa Corporation

This invention relates to a cathode composite for use in a primary battery and a secondary battery. In order to uniformly disperse a positive active material and a conductive agent in the cathode composite, wherein the cathode composite comprises a polar organic molecule, a chalcogen containing positive active compound, a conductive agent and a diluent, wherein the polar organic molecule has at least one acid structure based on phosphoric acid, sulfonic acid, boric acid, carboxylic acid or sulfuric acid and functions as a dispersant.

**5789110**

**CATHODE-ACTIVE MATERIAL BLENDS  
COMPRISING  $\text{Li}_x\text{Mn}_2\text{O}_4$  ( $0 < x < 2$  OR  $x = 2$ )**

Saidi Mohamed-Yazi; Barker Jeremy; Saidi Eileen S  
Henderson, NV, UNITED STATES assigned to Valence  
Technology Inc

A solid secondary lithium electrochemical cell comprises a physical mixture of  $\text{Li}_x\text{M}_2\text{O}_4$  (spinel) ( $0 < x < 2$  or  $= 2$ ) and at least one second compound selected from  $\text{LiFeO}_3$ ,  $\alpha\text{-LiFe}_5\text{O}_8$ ,  $\beta\text{-LiFe}_5\text{O}_8$ ,  $\text{LiFe}_3\text{O}_4$ ,  $\text{LiFe}_2\text{O}_3$ ,  $\text{Li}_{1+w}$ ,  $\text{Fe}_5\text{O}_8$  ( $0 < w < 4$ ),  $\text{Li}_y\text{V}_2\text{O}_5$  ( $0 < y < 2$ ), and  $\text{Li}_z\text{FeV}_2\text{O}_5$  ( $0 < z < 2$ ). The cell is particularly suitable for use with anodes carbon materials.

**5789112**  
**LITHIUM MANGANESE OXIDE**  
**COMPOUND AND METHOD OF**  
**PREPARATION**

Ellgen Paul C Oklahoma City, OK, UNITED STATES  
 assigned to Kerr-McGee Chemical Corporation

A method for manufacturing  $\text{Li}_2\text{M}_2\text{Mn}_2\text{-bO}_4$  which comprises the steps of providing  $\text{LiM}_2\text{Mn}_2\text{-bO}_4$ ; providing a lithium salt; forming a mixture of the  $\text{LiM}_2\text{Mn}_2\text{-bO}_4$  and lithium salt in a liquid medium; adding a reducing agent to the mixture; heating for sufficient time to effect substantially complete conversion; and separating the product  $\text{Li}_2\text{M}_2\text{Mn}_2\text{-bO}_4$

**5789115**  
**METHOD FOR PREPARING SPINEL**  
 **$\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4\text{+Y}$  INTERCALATION**  
**COMPOUNDS**

Manev Vesselin; Ebner Walter; Thompson William;  
 Dow Stephen Gastonia, NC, UNITED STATES  
 assigned to FMC Corporation

A novel method of preparing a highly homogenous spinel  $\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4\text{+Y}$  intercalation compound having a predetermined mean particle size and particle size distribution for 4 V secondary lithium and lithium ion cells is provided. The method comprises mixing at least one manganese compound having a predetermined particle size distribution with at least one lithium compound wherein the manganese compound has a mean particle size of between about 1 and 15 microns and the mean particle size of the lithium compound is less than that of the manganese compound. The mixture is then fired in one or more firing steps within specific temperature ranges to form the  $\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4\text{+Y}$  intercalation compound. Preferably, at least one firing step is at a temperature of between about 700°C and 900°C The  $\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4\text{+Y}$  intercalation

compounds may be used in the positive electrodes of secondary lithium and lithium ion cells to provide cells having high specific capacity, cycleability, and charge-discharge rate capability.

**5792442**  
**HIGHLY HOMOGENEOUS SPINEL**  
 **$\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4$  INTERCALATION**  
**COMPOUNDS AND METHOD FOR**  
**PREPARING SAME**

Manev Vesselin; Faulkner Titus Gastonia, NC,  
 UNITED STATES assigned to FMC Corporation

A novel method of preparing a spinel  $\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4$  intercalation compound with low lattice distortion and a highly ordered and homogeneous structure for 4 V secondary lithium and lithium ion cells is provided. The method of preparing the spinel  $\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4$  intercalation compound comprises mixing at least one manganese compound with at least one lithium compound and firing the mixture at three different temperature ranges with corresponding gas flow rates to form the spinel  $\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4$  intercalation compounds. The spinel  $\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4$  intercalation compounds have a mean X value of between about 0.01 and 0.05 and a full width at half maximum of the x-ray diffraction peaks at a diffraction angle 2 theta of planes (400) and (440) using CuK alpha1 rays of between about 0.10 degrees and 0.15 degrees. The spinel  $\text{Li}_{1+X}\text{Mn}_2\text{-XO}_4$  intercalation compounds may be used in the positive electrodes of secondary lithium and lithium ion cells to provide cells having high specific capacities and long cycling lives.

**5792577**  
**NEGATIVE ELECTRODE MATERIAL**  
**FOR USE IN LITHIUM-ION SECONDARY**  
**BATTERY AND PROCESS FOR**  
**PRODUCING THE SAME**

Ejiri Hiroshi; Yamazaki Yoshinor; Nakajima Hideyuki;  
 Nishimura Yoshiyuki Kamisu machi, JAPAN assigned  
 to Petoca Ltd

A negative electrode material for use in lithium-ion secondary batteries, comprising milled pitch-based graphite fibers (A) obtained by graphitization at 2400°C or higher and milled pitch-based carbon fibers (B)

obtained by carbonization at 550 degrees to 1300°C In this negative electrode material, it is preferred that both the milled pitch-based graphite fibers (A) and the milled pitch-based carbon fibers (B) have an average particle size of 10 to 30  $\mu\text{m}$ , that the ratio of milled pitch-based carbon and graphite fibers having a particle size of 5  $\mu\text{m}$  or less to all the milled pitch-based carbon and graphite fibers is not greater than 10% by weight and that the milled pitch-based graphite fibers (A) and the milled pitch-based carbon fibers (B) are blended at a weight ratio (A/B) of 95/5 to 40/60. A negative electrode which has a large capacity at the time of having been stabilized, exhibits a high charge and discharge efficiency at the initial stage and is excellent in charge and discharge cycle characteristics can be provided by the blending of milled pitch-based carbon fibers with milled pitch-based graphite fibers.

## ***LITHIUM BATTERIES***

**5763119**

### **NON-AQUEOUS ELECTROLYTE SECONDARY CELL HAVING SHUTTLE AGENT**

Adachi Momoe Tokyo, JAPAN assigned to Sony Corporation

In a non-aqueous electrolyte secondary cell according to the present invention, a particular redox shuttle is contained in an electrolyte, whereby an overcharge of the cell is effectively prevented. The non-aqueous electrolyte secondary cell comprising a negative electrode composed of a metal material containing lithium as a primary component or a carbonaceous material into which lithium can be doped and from which lithium can be dedoped, a positive electrode composed of a composite oxide of lithium and transition metal, and a non-aqueous electrolyte containing an organic compound of the general formula: (\*See Patent for Chemical Structure\*) where X represents a halogen atom.

**5763120**

### **LITHIUM MANGANESE OXIDE CATHODES WITH HIGH CAPACITY AND STABILITY**

Saidi M Yazid; Koksang Rene Henderson, NV, UNITED STATES assigned to Valence Technology Inc

A method for reducing capacity fading of an  $\text{LiMn}_2\text{O}_4$  spinel electrode active material comprising substituting a minor amount of Z for Mn in the  $\text{LiMn}_2\text{O}_4$  active material, where Z is a metal element having a +4 (IV) valence state and is characterized by an ability to form tetravalent chlorides. The Z substituted  $\text{LiMn}_2\text{O}_4$  active material is further characterized by a lesser rate of capacity loss with cycling as compared to  $\text{LiMn}_2\text{O}_4$  active material.

**5766796**

### **PASSIVATION-FREE SOLID STATE BATTERY**

Abraham Kuzhikalail M; Peramunage Dharmasena Needham, MA, UNITED STATES assigned to EIC Laboratories Inc

This invention pertains to passivation-free solid-state rechargeable batteries composed of  $\text{Li}_4\text{Ti}_5\text{O}_{12}$  anode, a solid polymer electrolyte and a high voltage cathode. The solid polymer electrolyte comprises a polymer host, such as polyacrylonitrile, poly(vinyl chloride), poly(vinyl sulfone), and poly(vinylidene fluoride), plasticized by a solution of a Li salt in an organic solvent. The high voltage cathode includes  $\text{LiMn}_2\text{O}_4$ ,  $\text{LiCoO}_2$ ,  $\text{LiNiO}_2$  and  $\text{LiV}_2\text{O}_5$  and their derivatives.

**5766797**

### **ELECTROLYTE FOR LI/SVO BATTERIES**

Crespi Ann M; Chen Kevin Minneapolis, MN, UNITED STATES assigned to Medtronic Inc

A lithium/silver vanadium oxide cell is disclosed that includes an improved electrolyte composition having the solvents propylene carbonate and 1,2-dimethoxyethane, and an additional third solvent that reduces the solubility of the composition of the silver vanadium cathode material. Preferably, the third solvent is a dialkyl

carbonate such as dimethyl carbonate, diethyl carbonate or ethylmethyl carbonate. The improved electrolyte composition reduces the build up of resistance in the cell during cell discharge, and can affect the cell's performance in implantable cardiac defibrillator applications.

### **5780181**

#### **NONAQUEOUS SECONDARY BATTERY**

Idota Yoshio; Mishima Masayuki; Miyaki Yukio; Kubota Tadahiko; Miyasaka Tsutomu Kanagawa, JAPAN assigned to Fuji Photo Film Co Ltd

A nonaqueous secondary battery comprising a positive electrode active material, a negative electrode active material, and a lithium salt is disclosed, in which the negative electrode active material contains (1) a compound capable of intercalating and deintercalating lithium comprising an atom of the group IIIB, IVB or VB of the periodic table, (2) an amorphous compound containing at least two atoms selected from the elements of the groups IIIB, IVB, and VB of the periodic table, (3) a compound capable of intercalating and deintercalating lithium containing at least one of the atoms of the group IIIB, IVB, and VB of the periodic table and fluorine, or (4) a compound of the metal of the group IIIB, IVB or VB of the periodic table, Zn, or Mg which is capable of intercalating and deintercalating lithium. The nonaqueous secondary battery of the invention exhibits improved charge and discharge characteristics and improved safety.

### **5780182**

#### **PROPYLENE CARBONATE BASED ELECTROLYTE FOR LITHIUM ION ELECTROCHEMICAL CELL**

Barker Jeremy; Gao Feng Henderson, NV, UNITED STATES assigned to Valence Technology Inc

Non-aqueous solid electrochemical cells with improved performance can be fabricated by employing intercalation based carbon anodes comprising graphite, coke, or mixtures thereof, and an electrolyte having an electrolyte solvent formed of propylene carbonate and 4,5-dichloroethylene carbonate. The cells are particularly suited for low temperature applications.

### **5780185**

#### **CATHODE MATERIALS FOR LITHIUM BATTERIES AND METHODS FOR PRODUCING THE SAME**

Oki Naohiko; Noguchi Minoru; Demachi Atsushi; Sato Kenji; Komazawa Eisuke; Araki Kazuhiro Wako, JAPAN assigned to Honda Giken Kogyo Kabushiki Kaisha

An amorphous solid solution of V<sub>2</sub>O<sub>5</sub>, CoO<sub>2</sub>, P<sub>2</sub>O<sub>5</sub>, MO (wherein M represents an alkaline earth metal element) and at least one lithium compound selected from the group consisting of lithium-oxygen compounds, lithium halides and lithium oxygen acid salts is formed by melting precursor materials therefore, then the melt is put into water or pressed with metal plates to quench it, and the solid solution is heat treated above its glass transition temperature, the resulting solid solution being used as a cathode material for a lithium battery, thereby obtaining the lithium battery preventing the capacity of a carbon anode from lowering and excellent in long-term cycle stability.

### **5783331**

#### **SECOND BATTERY COMPRISING A GEL POLYMER SOLID ELECTROLYTE AND A COPOLYMER OF VINYL PYRIDINE WITH A HYDROXYL-GROUP-CONTAINING (METH) ACRYLATE AS BINDER FOR THE NEGATIVE ELECTRODE**

Inoue Tomohiro; Ohsawa Toshiyuki; Taniuchi Masahir; Kurohara Takayuk; Miura Koji Sagamihara, JAPAN assigned to Ricoh Company Ltd; Koei Chemical Company Ltd

A secondary battery includes a positive electrode comprising a positive active material; an electrolyte layer including a gel polymer solid electrolyte; and a carbon-based negative electrode capable of occluding and releasing lithium, which contains a binder including a resin composition of a copolymer of (a) a vinyl pyridine compound of formula (1), (\*See Patent for Chemical Structure\*) (1) wherein R1 is a hydrogen atom, an alkyl group having 1 to 3 carbon atoms, or a halogen atom, and R2 is a hydrogen atom or an alkyl

group having 1 to 3 carbon atoms, and (b) a hydroxyl-group-containing (meth)acrylate compound.

**5783326**

**NONAQUEOUS ELECTROLYTE  
SECONDARY BATTERY**

Hasebe Hiroyuk Chigasaki, JAPAN assigned to Kabushiki Kaisha Toshiba

This invention provides a nonaqueous electrolyte secondary battery including a positive electrode capable of absorbing/desorbing lithium ions, a negative electrode capable of absorbing/desorbing lithium ions, a nonaqueous electrolyte, and a Positive Thermal Coefficient, wherein the Positive Thermal Coefficient satisfies expression (1) below (\*See Patent for Tabular Presentation\*)  $PS$  where  $R$  ( $m\ \Omega$ ) is the resistance at  $25^\circ\text{C}$  of the Positive Thermal Coefficient and  $P$  (Ah) is the nominal capacity of the secondary battery.

**5783332**

**POSITIVE ELECTRODE ACTIVE  
MATERIAL FOR LITHIUM BATTERY  
AND A METHOD FOR MANUFACTURING  
THE SAME**

Amine Khalil; Yasuda Hideo; Fujita Yuko Kyoto, JAPAN assigned to Japan Storage Battery Co Ltd

A positive electrode active material for lithium battery which is represented by general formula  $\text{Li}_x\text{Mn}_{2-y}\text{MyO}_4$  (M: a 2-valency metal selected from Ni, Co, Fe and Zn with  $0.45 < y < 0.60$ ,  $1 < x < 2.1$ ) having cubic spinel structure of lattice constant within 8.190 angstrom. Such an active material is manufactured by employing sol-gel process wherein one of inorganic salt, hydroxide and organic acid salt of lithium or a mixture of these for Li, one of inorganic salt and organic acid salt of manganese or a mixture of these for Mn, and one of inorganic salt and organic acid salt of the selected metal or a mixture of these for M are used as the starting materials for synthesis, ammonia water is added to the solutions of these starting materials in alcohol or water to obtain gelatinous material and the gelatinous material thus obtained is fired.

**5789105**

**USE OF P2O5 IN NON-AQUEOUS  
RECHARGEABLE LITHIUM BATTERIES**

Zhong Qimin; von Sacken Ulrich Coquitlam, CANADA assigned to Moli Energy (1990) Limited

The loss in delivered capacity as a function of the number of charge/discharge cycles in non-aqueous rechargeable lithium batteries can be reduced by exposing the electrolyte therein to  $\text{P}_2\text{O}_5$ . The exposure to  $\text{P}_2\text{O}_5$  can be accomplished by incorporating  $\text{P}_2\text{O}_5$  in either electrode or other locations that contact the electrolyte. Alternately, the electrolyte can be exposed prior to assembling the battery. The invention is particularly suited to certain lithium ion rechargeable battery electrochemistries.

**5789107**

**NONAQUEOUS POLYMER BATTERY**

Okada Mikio; Yasuda Hideo Kyoto, JAPAN assigned to Japan Storage Battery Co Ltd

A nonaqueous polymer battery includes a lithium ion conductive polymer having pores, a positive active material, and a carbonaceous negative active material. In the nonaqueous polymer battery, the positive active material is represented by  $\text{Li}_{1-x}\text{CoO}_2$  ( $0 < x < 1$ ) wherein the molar ratio of the carbon atoms in the negative active material to the cobalt atoms in the positive active material is 7.5 or lower; the positive active material is represented by  $\text{Li}_{1-x}\text{NiO}_2$  ( $0 < x < 1$ ) wherein the molar ratio of the carbon atoms in the negative active material to the nickel atoms in the positive active material is less than 10; or the positive active material is represented by  $\text{Li}_{1-x}\text{Ni}(\text{Co})\text{O}_2$  ( $\text{Li}_{1-x}\text{NiO}_2$  having not more than 20% of the nickel atoms thereof displaced with cobalt ions;  $0 < x < 1$ ) wherein the ratio of the number of the moles of the carbon atoms present in the negative active material to the total number of the moles of the cobalt atoms and the nickel atoms present in the positive active material is less than 10.

**5792574****NONAQUEOUS SECONDARY BATTERY**

Mitate Takehito; Nishijima Motoak; Tsukuda Yoshihir; Yamada Kazuo Yamatotakada, JAPAN assigned to Sharp Kabushiki Kaisha

A nonaqueous secondary battery is provided, which comprises a positive electrode, a negative electrode and a nonaqueous ion conductor, the negative electrode containing a lithium-containing substance or a lithium insertable and releasable substance as a positive electrode active material, the positive electrode containing a lithium nickelate compound as a positive electrode substance, wherein the lithium nickelate compound has a layered rocksalt crystalline structure belonging to Space Group R-3m and the ratio of a 3a- and 3b-site occupation rate of lithium atoms to a 3a- and 3b-site occupation rate of nickel atoms in the crystal lattice thereof is 0.85 to 1.15.

**5792575****LITHIUM SULFUR SECONDARY BATTERY AND ELECTRODE MATERIAL FOR A NON-AQUEOUS BATTERY**

Naoi Katsuhiko; Yamaguchi Takitar; Torikoshi Akihiko; Iizuka Hiroshi Tokyo, JAPAN assigned to Yazaki Corporation

A lithium sulfur secondary battery is provided with a cathode containing a highly basic polymer compound in a composition or in a form of a film. The lithium sulfur secondary battery gives a longer cyclic life of charging/discharging and high energy density.

**5792576****LIMITED RECHARGEABLE LITHIUM BATTERY BASED ON A CATHODE SLURRY**

Xing Xuekun; Kalnoki-kis Tibor; Moutsios George Richmond Heights, OH, UNITED STATES assigned to Gould Electronics Inc

The present invention provides a limited rechargeable lithium battery containing an anode; a cathode slurry containing about 55 to about 75% by weight of a

transition metal oxide, about 3 to about 8% by weight of a conductor, and about 20 to about 40% by weight of an organic electrolyte containing an electrolyte salt and an organic solvent; a separator between the anode and the cathode slurry; and at least two current collectors. The present invention also provides a method of making a cathode slurry.

**NICKEL METAL HYDRIDE BATTERIES****5763115****RESETTING THE PRECHARGE OF A GROUP OF PRESSURIZED GAS ENERGY STORAGE CELLS DURING SERVICE**

Stadnick Steven J; Rogers Howard Lakewood, CA, UNITED STATES

A group of electrically interconnected energy storage cells, such as nickel-hydrogen energy storage cells, is pressure balanced and its precharge reset by discharging the energy storage cells of the group to a substantially fully discharged state, venting all of the energy storage cells of the group to the same reduced internal hydrogen pressure, and thereafter discontinuing the venting. The venting occurs without recharging the energy storage cells, and after venting is complete the energy storage cells of the group are recharged.

**5763116****NICKEL HYDROGEN BATTERY APPARATUS**

Lapinski John; Buck John P St Charles, MO, UNITED STATES assigned to McDonnell Douglas Corporation

A battery apparatus which includes a battery housing having a plurality of battery cell receptacles, each of the battery cell receptacles having an inwardly tapered opening. A plurality of battery cells are respectively inserted in the battery cell receptacles, and electrodes of each battery cell are connected via wires or bus bars to electrodes of another battery cell. A collar is secured to and surrounds each of the plurality of battery cells, the collar being located at a central portion of the battery cells. A portion of the collar is inwardly tapered, with the inward taper of the battery cell receptacle matching the inward taper of the collar. Retaining tabs secure each battery cell and its respective collar to the battery



housing. An adhesive material is applied to a surface of the central portion of each battery cell, with the adhesive material bonding to an inner surface of the respective collar. An electrically insulating material is also embedded in the adhesive material.

**5766799**

**METHOD TO REDUCE THE INTERNAL  
PRESSURE OF A SEALED  
RECHARGEABLE HYDRIDE BATTERY**

Hong Kuochih Troy, MI, UNITED STATES

This invention provides a method to reduce the internal pressure of a hydride battery, particularly a sealed type. The battery, according to this invention, is composed of a container, a positive electrode, a negative electrode suitable for various temperatures comprising at least two hydrogen storage electrode materials and/or their hydrides, a separator positioned between the positive and negative electrodes, and an electrolyte in the container and in contact with the positive and negative electrodes and the separator. The negative electrode is a hydrogen storage hydride electrode which is composed of at least two hydrogen storage electrode alloys having compositions represented by  $AaBbCc$  . . . and  $A'a,B'bC'c$ , . . . respectively; where the set of elements: A, B, C, . . . and the set of elements: A', B', C', . . . both consist of 6 to 80 at. % of nickel, preferably 24-55 at. % nickel; and at least four other elements chosen from the group consisting of Mg, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Al, Y, Zr, Nb, Pd, Ag, Mo, Ca, Si, C, Cu, Ta, Ca, rare earth metals, B, Hf, Sc, Zn, Sb, W, Sn, N, O, Ge, Ga, the alkali metals, P, and S; the sets of atomic mole ratio a, b, c, . . . and a', b', c', . . . are defined by the heats of hydride formation Hh and H'h respectively; where Hh and H'h are in a range of between -2.50 and -10.50 Kcal/mole H, preferably between -3.50 and -8.50 Kcal/mole H; and at least one of the compositions consists of more than 40 at. % of nickel, preferably more than 47 at. % of nickel; and at least one of the heats of hydride formation of the alloys is in the range between -7.50 and -2.50 Kcal/mole H, preferably between -7.08 and -2.80 Kcal/mole H.

**5788720**

**METHOD FOR MANUFACTURING  
POSITIVE ELECTRODE PLATES FOR AN  
ALKALINE STORAGE BATTERY**

Asano Shuji; Noguchi Yasutak; Tsuboi Ryoji  
Kamakura, JAPAN assigned to Matsushita Electric  
Industrial Co Ltd

An alkaline storage battery configured with an improved nickel positive electrode plate having a high capacity density and a high utilization of the active material is disclosed. The nickel positive electrode plate comprises a porous metal plaque, a first layer of nickel hydroxide loaded in close proximity to inner surfaces of pores of the porous metal plaque, and a second layer of nickel hydroxide loaded over the first layer. The nickel hydroxide in the second layer has a larger particle diameter than that in the first layer, and the amount of the nickel hydroxide in the second layer occupies a majority of the total amount of the active material filled in the positive electrode.

**5789097**

**GAS-TIGHT MAINTENANCE-FREE CELL  
OR BATTERY**

Kistrup Holger; Imhof Otwin Esslingen, GERMANY  
assigned to Deutsche Automobilgesellschaft mbH

A gas-tight maintenance-free cell or battery comprises positive nickel oxide electrodes having a fibrous structure, gas-impermeable separators, a fixed alkaline electrolyte, negative metal electrodes having a fibrous structure and a higher charging and discharging capacity than in the case of the positive electrodes, and electroconductive gas diffusion compartments. The cell operating according to the oxygen cycle. The metallized fibrous-structure electrode frameworks of the negative electrodes are filled with the active material only in certain zones. Those zones of the fibrous-structure electrode frameworks of the negative electrode which are not filled with the active material, serve as gas diffusion zones, integrated into the frameworks, for the oxygen to be discharged at the negative electrode.

**5789113****ACTIVE MATERIAL FOR NICKEL  
ELECTRODE AND NICKEL ELECTRODE  
HAVING THE SAME**

Joo Kyu-nam; Choi Jong-seo; Choi Kwi-seuk; Kim Geun-bae; Lee Sang-won Seoul, KOREA assigned to Samsung Display Devices Co Ltd

An active material for a nickel electrode includes a double hydroxycarbonate having the formula  $Ni_{1-2x}M_{2x}(OH)_2(CO_3)_x \cdot nH_2O$ , where  $0.05 < x < 0.2$ ,  $0.05 < n < 4$ , and M is a Group IIIB element and containing 1-40 at % of a III B group element in a solid solution, based on the weight of nickel, and 1-20 wt % of a conductive enhancer which is at least one substance selected from the group consisting of Co and cobalt compound, based on the weight of the double hydroxycarbonate, so that a nickel electrode having a high capacity, increased life time, high charge/discharge velocity and enhanced utility of the active material can be produced. Alkaline secondary cells can be manufactured using the nickel electrode.

**COMPONENTS AND/OR CHARGERS****5766790****SAFETY DEVICE FOR USE IN  
SECONDARY BATTERY**

Kameishi Toshiz; Izawa Tadayuki; Kihara Koji; Imoto Akira; Hayashi Toshiharu Gose, JAPAN assigned to Wako Electronics Co Ltd

A safety device for use in a secondary battery having a battery case formed with a hole open to outside of the battery case, and a generating unit airtightly housed in the battery case. The safety device includes a disk spring mounted on the battery case to close the hole and having one side thereof convexed toward the inside of the battery case. A switch is provided on the backside of the disk spring. It is adapted to change over under a stress applied from the disk spring when the disk spring bends backward so that the other side thereof is convexed toward the outside of the battery case. The switch is provided in a current flow path of the secondary battery.

**5766793****SAFETY DEVICE FOR USE IN  
SECONDARY BATTERY**

Kameishi Toshizou; Hayashi Toshiharu Gose, JAPAN assigned to Wako Electronics Co Ltd

A safety device for a battery which can prevent explosion of the battery due to overcharging or shortcircuiting. In the safety device, a current flows through generating unit, lead, terminal of a conductor case, PTC plate, annular terminal, contact to electrode lid. A disk spring, generally called a bimetal, is adapted to bend backward when it is heated to a predetermined temperature. If the generating unit heats up by producing gas due to overcharging or shortcircuiting, the disk spring is heated. When heated to a predetermined temperature, it will bend backward, while pushing up a moving piece, which in turn pushing up the contact, thus separating the contact from the annular terminal. The current-flow path in the battery is thus cut, so that the generating unit will not heat up any further.

**5770938****REAL TIME CHARGING CONTROL OF A  
FAST BATTERY CHARGER**

Kao Hsueh-Wu Hsinchu, CHINA (TAIWAN) assigned to Industrial Technology Research Institute

Methods and circuits are disclosed which terminate charging of a battery when the maximum charge is reached. Maximum charge is reached when the battery voltage has peaked, after a long rise, and just starts to drop. This small voltage drop, or delta, is detected by a charger control which compares the real time battery voltage with a previously sampled battery voltage. Upon detecting this small voltage drop, the charger control terminates the charging process. Implementations using an analog delta voltage detection and a digital delta voltage detection are described.

**5783929****APPARATUS AND METHOD FOR  
RECHARGING A BATTERY**

Taricco Todd Zephyr Cove, NV, UNITED STATES

An apparatus and method for recharging a battery. The invention includes modulating a rail voltage with a modulation signal that oscillates at a radio frequency, preferably at a frequency that matches the natural resonant frequency of the battery. The modulated rail voltage is provided to the battery to recharge the device. The apparatus may have a follower circuit which shifts the modulation frequency to follow any change in the natural resonant frequency of the battery.

**5789902**

**BI-DIRECTION CURRENT CONTROL  
CIRCUIT FOR MONITORING  
CHARGE/DISCHARGE OF A BATTERY**

Abe Noboru; Ito Kohei Fukaya, JAPAN assigned to Hitachi Metals Ltd; Hitachi Maxell Ltd

A battery-monitoring circuit includes a bidirectionally current-controllable means disposed between a secondary battery and a charging circuit or a load circuit for monitoring the charge or discharge of the secondary battery to prevent undesirable charging. The current control means has characteristics as an active diode, which is constituted by an error amplifier to which a predetermined voltage and voltage between both terminals of the current control means are supplied. The current control means supplies an output to the current-controllable means, such that the output of the current-controllable means is controlled constant, equal to the predetermined voltage.

**5789903**

**METHOD AND APPARATUS FOR  
PROCESSING BATTERIES**

Young Malcolm; Angilley Phillip Strathfield, AUSTRALIA assigned to Seymour John York

PCT No. PCT/AU95/00174 Sec. 371 Date Oct. 23, 1996 Sec. 102(e) Date Oct. 23, 1996 PCT Filed Mar. 28, 1995 PCT Pub. No. WO95/26588 PCT Pub. Date Oct. 5, 1995. A method and apparatus for processing rechargeable batteries include using a processor arranged to monitor the voltage of a battery when it is being discharged and to terminate the discharge after detecting that the rate of change of the voltage has

passed through a termination pattern indicative of exhaustion of a cell of the battery. The determination is made by monitoring the voltage during discharge and detecting when the voltage curve thereof exhibits first convexity followed by concavity. The degree of convexity and concavity, and the time interval within which they must occur, are determined by the processor. The discharge is also terminated if the voltage reaches a predetermined voltage or if, after the termination pattern is detected, and before the voltage has reached a predetermined voltage, a predetermined amount of charge is removed from the battery. The invention also envisages recharging the battery first at high rate until the amount of charge returned to the battery is no more than the charge removed from the battery before the discharge was terminated. The charge may then be continued at a lower rate until the battery is overcharged to a predetermined extent.

**5789923**

**BATTERY REMAINING CAPACITY  
MEASURING DEVICE**

Shimoyama Kenichi; Saigo Tsutomu Susono, JAPAN assigned to Yazaki Corporation

In a battery remaining capacity measuring device, a current sensor and a voltage sensor detect currents flowing through a load and voltages at both terminals of a battery. A voltage-current changing tendency calculating section collects the detected terminal voltages and the detected currents at every predetermined time, and averages a plurality of terminal voltage values and a plurality of current values at each time when the terminal voltage values and the current values are collected to a predetermined number. A voltage-current approximating line calculating section calculates a voltage-current approximating line using a method of least square having currents as the x-axis and voltages as the y-axis based on the predetermined number of the averaged current values and the averaged voltage values at each time when the averaged voltage values and current values reach the predetermined number. A remaining capacity calculating section estimates a voltage value of the voltage-current approximating line corresponding to a reference current value at each time when the voltage-current approximating line is determined.

**5789924**  
**METHOD OF CALCULATING**  
**RECHARGEABLE BATTERY CHARGE**  
**CAPACITY**

Okada Tetsuya Sumoto, JAPAN assigned to Sanyo Electric Co Ltd

The method of calculating rechargeable battery charge capacity of this invention has steps to temporarily interrupt charging and calculate battery internal impedance, to calculate a no-load battery voltage by subtracting the product of internal impedance and charging current from the battery voltage when charging current is supplied, to calculate charging power by multiplying no-load voltage and charging current, and to repeatedly perform the charging power calculation integrating that charging power result to compute battery charge capacity.

***OTHER BATTERIES***

**5763117**  
**ELECTROCHEMICAL CELL**

Wright Michael L; Meintjes Anthony A Allestree, UNITED KINGDOM assigned to Electro Chemical Holdings Societe Anonyme

A high temperature rechargeable electrochemical cell comprises a housing in the form of a canister which is polygonal in cross-section so that it has a plurality of peripherally spaced corners. A solid electrolyte separator which is a conductor of sodium ions, separates the interior of the housing into an anode compartment containing an anode and a cathode compartment containing a cathode. The separator is tubular or cup-shaped, having a closed end and an open end, and having a plurality of peripherally spaced radially outwardly projecting ribs or lobes corresponding in number to the corners of the housing. The separator is concentrically located in the housing, with each lobe of the separator being peripherally aligned with, and projecting towards, one of said corners of the housing. Anchoring components anchoring the separator in position relative to the housing, are provided. The anchoring component comprises a first portion spanning a gap between the housing and the separator, between a pair of lobes of the separator, and a second portion protruding from the first portion and engaging a surface of a lobe of the separator. Sodium is provided as active

anode material in the anode compartment, with the cell having an operating temperature at which the sodium is molten, while active cathode material is provided in the cathode compartment.

**5766791**  
**SEALED NONAQUEOUS SECONDARY**  
**BATTERY**

Takahashi Osamu; Andou Shigeru; Nakamura Wataru; Suzuki Hisashi Kanagawa, JAPAN assigned to Fuji Photo Film Co Ltd

A sealed nonaqueous secondary battery comprising a sealed-end battery case containing an electrodes assembly composed of a cathode, and an anode both capable of intercalating and deintercalating a light metal, a separator therebetween and a nonaqueous electrolytic solution, the opening of said battery case being sealed with an insulating gasket which is provided at the inner periphery of said opening and a sealing part which is held by the gasket and serves as a cathode or anode terminal, wherein the sealing part comprises an explosion-proof valve which is capable of being deformed to the direction opposite to the electrodes assembly with an increase in internal pressure, a vented terminal cap which is provided above the explosion-proof valve in the side opposite to the electrodes assembly, and a current breaker which is provided between the explosion-proof valve and the terminal cap; the current breaker having a piled structure composed of a first electric conductor having a penetrated hole which is provided at a side of the explosion-proof valve, an intermediate insulator having a penetrated hole at the central portion thereof, and a second electric conductor having a penetrated hole which is provided at a side of the terminal cap; the first electric conductor and the second electric conductor being electrically connected at the center thereof; and the first electric conductor having a thin part at the periphery of its joint with the second electric conductor.

**5766801**  
**LAYER BUILT SEALED ALKALINE**  
**STORAGE BATTERY**

Inoue Hiroshi; Hamada Shinji; Ikoma Munehisa Neyagawa, JAPAN assigned to Matsushita Electric Industrial Co Ltd

A layer-built sealed alkaline storage battery includes plural rectangular cell units 11. Those cell units 11 are arranged in a row and united together with a pair of end plates 1 and 2 arranged at the opposite sides of the assembly of the cells by belt-like clamp bands 37, 38 each extending cross from one of the end plates 1 through the cell units 11 to the other of the end plates 2 and being fixed at the end thereof on the end plates 1, 2. Each end plate 1 or 2 is of one-piece structure having 1) a generally rectangular panel portion or portions 26 and 2) a peripheral wall frame 26 and 3) reinforcement ribs 23a to 23c, so that the assembly of the cell can be united so as to be prevented from deformation due to expansion and vibration of the cells.

**5770333**

**NONAQUEOUS SECONDARY BATTERY  
AND NEGATIVE ELECTRODE  
MATERIAL THEREFOR**

Saito Akihiko; Aono Yasuhisa; Horiba Tatsuo; Kodama Hideyo; Dozono Toshinori; Inagaki Masahisa Hitachi, JAPAN assigned to Hitachi Ltd

A non-aqueous secondary battery having a long life-time and a high capacity density is provided by increasing the discharging capacity of the negative electrode and extending the life-time of the negative electrode. The nonaqueous secondary battery has a positive electrode and a negative electrode reversibly absorbing and discharging an alkaline metal and a nonaqueous electrolyte, wherein the negative electrode is made of an inter-metallic compound containing at least one element selected from the group consisting of 4A group elements, P and Sb, the inter-metallic compound has any one of CaF<sub>2</sub> type, ZnS type and AlLiSi type crystal structures, and the CaF<sub>2</sub> type structure is any one an inverse-fluorite structure and a fluorite structure having a lattice constant larger than 6.36 #521 .+RE+RE.+RE+RE.+RE

**5780180**

**SEALED ALKALINE STORAGE BATTERY**

Okamoto Miho; Hamada Shinji; Ikoma Munehisa Sakai, JAPAN assigned to Matsushita Electric Industrial Co Ltd

The present invention provides a sealed alkaline storage

battery comprising a container of polymer alloy mainly comprised of PPE and an olefin resin and containing PPE of 20-60 wt %, or a composite material of polymer alloy containing PPE and an inorganic powder of 5-50 wt %. Using this material as a container, it is possible to restrict decrease in an amount of electrolyte thereby providing a sealed alkaline storage battery having a long life, which is possible to guarantee a maintenance-free long life of 7-10 years.

**5780184**

**NEGATIVE ELECTRODE FOR AN  
ALKALINE CELL**

Coco Isabelle; Cocciantelli Jean-Michel; Villenave Jean-Jacques Talence Cedex, FRANCE assigned to SAFT

The present invention concerns a negative electrode for an alkaline cell, comprising a current collector supporting a paste containing an electrochemically active material and a binder, characterized in that said binder is a polymer containing hydrophilic and hydrophobic groups, said polymer being selected from an acrylic homopolymer, copolymer and terpolymer, an unsaturated organic acid copolymer and an unsaturated acid anhydride copolymer.

**5780186**

**HIGH PERFORMANCE ZINC ANODE FOR  
BATTERY APPLICATIONS**

Casey John E League City, TX, UNITED STATES assigned to The United States of America as represented by the Administrator of the National Aeronautics and Space Administration

An improved zinc anode for use in a high density rechargeable alkaline battery is disclosed. A process for making the zinc electrode comprises electrolytic loading of the zinc active material from a slightly acidic zinc nitrate solution into a substrate of nickel, copper or silver. The substrate comprises a sintered plaque having very fine pores, a high surface area, and 80-85 percent total initial porosity. The residual porosity after zinc loading is approximately 25-30%. The electrode of the present invention exhibits reduced zinc mobility, shape change and distortion, and demonstrates reduced dendrite buildup during cycling of the battery. The

disclosed battery is useful for applications requiring high energy density and multiple charge capability.

### **5785839**

## **COMPOSITE STRUCTURE INCLUDING A SOLID ELECTROLYTE AND AT LEAST ONE VOLUME ELECTRODE**

Kleitz Michel; Mairesse Gaacuetan; Boivin Jean-Claude; Lagrange Gilles Grenoble, FRANCE assigned to Ecole Nationale Supérieure de Chimie de Lille Université des Sciences et Technologies de Lille; L'Air Liquide Société Anonyme pour l'Étude et l'Exploitation des Procédés Georges Claude

PCT No. PCT/FR95/00651 Sec. 371 Date Jan. 29, 1997 Sec. 102(e) Date Jan. 29, 1997 PCT Filed May 18, 1995 PCT Pub. No. WO95/32050 PCT Pub. Date Nov. 30, 1995. A composite structure comprising: (i) a solid electrolyte which is an O<sup>2-</sup>-anion conductor and essentially impermeable to gases; (ii) a cathode; and (iii) an anode, wherein the cathode and anode are porous to gases and wherein the electrolyte is in contact with the cathode and anode, wherein at least one of the cathode and anode is a voluminal electrode comprising (a) at least one BIMEVOX compound and (b) an electronic conductor, forming a distinct solid phase, dispersed in the BIMEVOX compound so as to define, within respective volumes of the voluminal electrode, a plurality of triple contact points between an ambient gaseous atmosphere, the electrolyte, and the electronic conductor.

### **5789096**

## **GAS-TIGHT ALKALINE ACCUMULATOR WITH VALVE ASSEMBLY**

Kilb Manfred Frankfurt am Main, GERMANY assigned to Christoph Emmerich GmbH & Co KG

PCT No. PCT/DE94/00835 Sec. 371 Date Apr. 15, 1996 Sec. 102(e) Date Apr. 15, 1996 PCT Filed Jul. 16, 1994 PCT Pub. No. WO95/04381 PCT Pub. Date Feb. 9, 1995. In a gas-tight alkaline accumulator with a casing which at least partially comprises plastic material and in which are arranged electrodes which are surrounded by an electrolyte and which are respectively separated from each other by a separator, wherein the electrodes are connected to pole contacts for electric

current to be fed to and away therefrom, in order to increase the operating reliability of the accumulator and to avoid further disadvantages, there is provided a valve having an opening which passes through the casing of the accumulator, and a deformable element which, in the event of an increased pressure occurring within the casing, provides for liberation of the opening and, after a drop in the increased pressure, closing of the opening.

### **5789104**

## **BUTTON-TYPE BATTERY WITH IMPROVED SEPARATOR AND GASKET CONSTRUCTION**

Blonsky Peter; Tuttle Mark E Boise, ID, UNITED STATES assigned to Micron Communications Inc

A button-type battery has an anode, a cathode, and an electrolyte encased with two terminal housing members. The terminal housing members have respective peripheries that are crimped together to form a fluid-tight seal. An insulating gasket is provided between the peripheries to electrically insulate the two terminal housing members. A porous separator physically separates the anode and cathode and extends between the terminal housing member peripheries at least partially into the fluid-tight seal. According to one aspect, the separator overlaps the gasket in the seal. According to another aspect, the separator and gasket are formed of a single, integral piece of material.

### **5789111**

## **NON-AQUEOUS ELECTROLYTE SECONDARY CELL AND METHOD OF MANUFACTURING SAME**

Ozaki Yoshiyuki; Koshina Hizuru Neyagawa, JAPAN assigned to Matsushita Electric Industrial Co Ltd

A non-aqueous electrolyte secondary cell having high charging efficiency over a wide temperature range, including low temperature, high energy density and superior charge and discharge cycle life, provided with a negative electrode manufactured with mesophase graphite particles obtained by a process to carbonize and then fully graphitize with a pulverizing process added before or after the carbonization.



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