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Journal of Power Sources

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LEAD ACID

6045940
FLOODED LEAD ACID BATTERY WITH TILT-OVER CAPABILITY

Fred F. Feres, USA assigned to Exide Corporation

In a battery configuration including a casing having bottom, side and top surfaces, the top surface having a plurality of cell openings therein, an improved flowpath is provided for liquid electrolyte when the battery is tilted onto any one of its side surfaces. The flowpath includes a cover chamber for each cell opening defined by a substantially rectangular peripheral wall surrounding the cell opening; a cylindrical wall surrounding and substantially concentric with the cell opening and located within the substantially rectangular wall, the cylindrical wall interrupted by a relatively small circumferential gap, and a wall extending between the cylindrical wall and an adjacent side of the peripheral wall, the wall tangential to the cylindrical wall and adjacent the gap.

6045949
APPARATUS FOR IMPROVING THE COMPRESSION UNIFORMITY OF A CELL STACK IN A BATTERY

Roy Kuipers, Patrick Kwok-Yeung Ng, USA assigned to Lucent Technologies Inc.

A battery grid has a thickness which is greater at the top than at the bottom to achieve a uniform compressive force on a grid stack exerted by the side walls of a battery container. A plastic wedge is disposed between the side walls of the battery container and the stack of grids to improve the distribution of compressive forces.

6053221
BATTERY FILLING APPARATUS

Kelly L. Eberle, William K. Eberle, USA assigned to Eberle Equipment Company Inc.

The apparatus includes a battery support for supporting a battery at a fill position, a head assembly with a plurality of heads each with an opening formed therethrough, an acid tank, a circulating conduit with a pump for circulating acid, and a valve for stopping the circulation of acid. The head assembly is moved from an upper position to a lower position for engaging the head openings with the upper cell openings of the battery. A plurality of fill conduits extend from the circulating conduit between the pump and the valve to the heads for injecting acid into the battery openings by way of the head openings. A plurality of leveling tubes extend through the head openings and beyond the lower ends of the heads for with removing excess acid by way of a plurality of leveling chambers operated together with a piston. For use with batteries that have an upper manifold and a side opening, a low pressure air injection device is employed to inject low pressure air into the upper manifold when the battery is being filled with acid.

6054084
METHOD OF MAKING A GAS RECOMBINANT BATTERY SEPARATOR

Mehrgan Khavari, OR, USA.

A recombinant lead acid battery separator formed of a PTFE fibril matrix and a particulate, amorphous silica filler enmeshed in the PTFE matrix. The separator has a tensile strength >0.5 MPa, a bulk density lower than about 0.40 g/cc and a void volume greater than about 75%. The separator is made by mixing together PTFE and a non-evaporative lubricant, adding amorphous silica during mixing, continuing mixing until a material having a dough-like consistency is obtained, removing the dough-like material and calendering it to form a sheet, removing from about 95 to 100% by weight of the non-evaporative lubricant from the sheet by solvent extraction, and drying the extracted sheet.

FUEL CELL

6045772
METHOD AND APPARATUS FOR INJECTING A LIQUID HYDROCARBON FUEL INTO A FUEL CELL POWER PLANT REFORMER

Donald F. Szydlowski, Richard A. Sederquist, USA assigned to International Fuel Cells LLC

A fuel atomizer for a liquid hydrocarbon fuel reformer/processor creates a high velocity atomized stream of a liquid fuel and steam, wherein the liquid fuel is quickly vaporized so as to limit carbon deposition from the fuel on the fuel vaporizer surfaces. The injector includes a small diameter fuel injection tube through which the liquid fuel and steam mixture is ejected at relatively high velocities. The liquid fuel forms an annular film which surrounds a steam core in the tube, which liquid droplet film and steam core composite are ejected from the tube into a stream of super heated steam, or steam and air. The stream of super heated steam substantially instantaneously vaporizes the fuel droplets from the film after the latter leaves the injection tube.

6045933
METHOD OF SUPPLYING FUEL GAS TO A FUEL CELL

Takafumi Okamoto, Japan assigned to Honda Giken Kogyo Kabushiki Kaisha

A fuel gas supply device is equipped with a reformer for conducting steam reforming of methanol which is supplied from a methanol tank, and a hydrogen gas supply means for supplying hydrogen gas only, which is contained in the fuel

gas derived from the reformer, to a fuel cell. By passing the fuel gas through a hydrogen permeable membrane or a pressure-swing adsorption device, a fuel gas in which any unreacted methanol is reliably removed therefrom can be supplied to the fuel cell. According to further embodiments, unreacted methanol is caused to positively react on a fuel electrode side of a fuel cell stack, so as to remove excess amounts of unreacted methanol from a fuel chamber. The method can further include a step of controlling the humidity of the fuel gas, by either removal or supply of moisture, before the fuel gas is supplied to the fuel cell.

6045934
SOLID POLYMER ELECTROLYTE FUEL CELL

Yoshiaki Enami, Japan assigned to Fuji Electric Company Ltd.

A lightweight and inexpensive solid polymer electrolyte fuel cell having a simple structure wherein a stack is efficiently cooled to be able to cope with a high output density. Fuel gas flows through a fuel gas flow path provided in the stack while flowing air as an oxidizing agent through air reactive gas flow path to generate electric power. An air cooling gas flow path is provided inside the stack. Water is added to air fed from an air feed blower with a water feed unit. Humidified air flows through the air cooling gas flow path, and then flows through the air reactive gas flow path. Discharged air is cooled in a condenser to condense water, and the resulting condensed water is recirculated to the water feed unit.

6045935
FLEXIBLE INORGANIC ELECTROLYTE FUEL CELL DESIGN

Thomas D. Ketcham, William Robert Powell, Ronald L. Stewart, Dell J. St. Julien, USA assigned to Corning Incorporated

Fuel cell designs incorporating non-planar inorganic electrolyte membranes offer improved mechanical and thermal shock resistance for mobile power generation systems, e.g. for high temperature fuel cell applications using liquid fuel (diesel and gasoline) and air for automobile power plants and other power systems requiring only intermittent high-temperature fuel cell operation.

6048383
MASS TRANSFER COMPOSITE MEMBRANE FOR A FUEL CELL POWER PLANT

Richard D. Breault, Thomas F. Fuller, Leslie L. Van Dine, USA assigned to International Fuel Cells L.L.C.

A mass transfer composite membrane for use with a fuel cell power plant includes a transfer medium core between opposed, rigid, porous support sheets. An inlet surface of the composite membrane is positioned in contact with an oxidant inlet stream of a fuel cell power plant, and an opposed exhaust surface of the composite membrane is positioned in contact with an exhaust stream exiting the fuel cell power plant to recover mass such as water from the exhaust stream and transfer it into the oxidant inlet stream entering the fuel cell. The transfer medium core may comprise any of a variety of materials for sorbing a fluid substance consisting of polar molecules such as water molecules from a fluid stream consisting of polar and non-polar molecules. A preferred transfer medium core is an ionomeric membrane such as a water saturated polyfluorosulfonic acid ionomer membrane. The porous support sheets may comprise a reinforcing fiber with a thermoset resin, such as a carbon sheet with a phenolic resin, or a glass fiber with an epoxy resin, wherein the sheets are thermoset into a rigid configuration. The mass transfer composite membrane may be a flat or a mounded layer defining protrusions and depressions. A plurality of the mounded layer membranes may be disposed within a frame in mirror-image association wherein protrusions and depressions formed by the mounds of adjacent membranes contact each other to define serpentine passages for the inlet and exhaust streams.

6048633
FUEL CELL STACK

Yosuke Fujii, Takafumi Okamoto, Manabu Tanaka, Akio Yamamoto, Hidemitsu Ono, Narutoshi Sugita, Japan assigned to Honda Giken Kogyo Kabushiki Kaisha

A fuel cell stack comprises first and second separators for holding a fuel cell unit therebetween. The first separator has a fuel gas flow passage and the second separator has an oxygen-containing gas flow passage. The gas flow passages are formed by grooves with the number of grooves decreasing from the inlet to the outlet. In one embodiment, the gas flow passage comprises 12 individual first gas flow passage grooves which communicate with an inlet hole on a gas inlet side, six individual second gas flow passage grooves which communicate with the first gas flow passage grooves, and three individual third gas flow passage grooves which communicate with the second gas flow passage grooves. The third gas flow passage grooves communicate with an outlet hole on a gas outlet side.

6048634
FUEL CELL USING WATER-SOLUBLE FUEL

Arthur Kaufman, Peter L. Terry, USA assigned to H Power Corporation

A reactant flow system for a proton exchange membrane (PEM) fuel cell stack using a water-soluble fuel is described.

The flow system includes the use of single-pass or multi-pass, flow channels. A flow channel section having at least one adjacent channel section whose reactant flows in an opposite direction thereto. The system has respective reactant inlets that are effectively adjacent to reactant outlets of the adjacent channel section. Restrictions are used at the reactant inlets to assure substantially uniform reactant flow among all of the flow channels.

6048635
POLYMERIC HEADER FOR FUEL CELL PRESSURE PLATE ASSEMBLIES

Robin Jay Guthrie, USA assigned to International Fuel Cells Corporation

The end plate assemblies in a fuel cell stack are conductive and made from metal that is susceptible of corroding in the hostile fuel cell environment. Coolant fluid circulates through these plates. Reactants must also be fed through the end plate assemblies plate. The reactant and coolant fluids are delivered through manifolds that communicate with each cell. Savings in weight and improvements in corrosion resistance are achieved by fabricating headers for these pressure plates of polymeric material. Each header has fluid inlet or outlet ports and internal passageways that communicate with passageways in the cell assemblies located between the metal pressure plates.

6048636
ELECTRODE SUBSTRATE FOR FUEL CELL

Aristides Naoumidis, Frank Tietz, Detlev Stover, Germany assigned to Kernforschungszentrum Julich GmbH

In an electrode for a fuel cell which has a porous self-supporting layer and another layer with catalytic properties disposed on said self-supporting layer, the self-supporting layer has a thickness several times greater than that of the layer with the catalytic properties and consists of a cermet comprising Al_2O_3 or TiO_2 to which Ni is admixed.

6050331
COOLANT PLATE ASSEMBLY FOR A FUEL CELL STACK

Richard D. Breault, Ronald G. Martin, Robert P. Roche, Glen W. Scheffler, Joseph J. O'Brien, USA assigned to International Fuel Cells L.L.C.

The coolant plate component of a fuel cell assembly is formed from a plate made from graphite particles that are bonded together by a fluorocarbon polymer binder and which encapsulate a serpentine coolant circulation tube. The coolant plate component is non-porous. The graphite particles are preferably flakes which pack together very tightly, and require only a minor amount of the polymer binder to form a solid plate. The plate will provide enhanced heat transfer, will conduct electrons, and will block electrolyte migration from cell to cell in a fuel cell stack due to its construction. The composition of the plate is graded so as to provide a varied coefficient of thermal expansion as measured through the thickness of the plate so as to reduce thermal stresses imposed on the fuel cell stack. The coolant circulation tube has a roughened outer surface which enhances adhesion of the encapsulating graphite flake/binder mixture without inhibiting heat transfer.

6051173
METHOD OF MAKING A SOLID OXIDE FUEL CELL WITH CONTROLLED POROSITY

Benjamin V. Fasano, Kevin M. Prettyman, USA assigned to International Business Machines Corporation

Disclosed is a method of making a solid oxide fuel cell with controlled porosity by varying the size of the ceramic particles, the type of organics, the sintering cycle and the amount of catalyst.

6051329
SOLID OXIDE FUEL CELL HAVING A CATALYTIC ANODE

Benjamin V. Fasano, Kevin M. Prettyman, USA assigned to International Business Machines Corporation

Disclosed is an SOFC having a catalytic anode including a porous, ceramic anode including a catalyst, wherein the catalyst is selected from the group consisting of platinum, rhodium, ruthenium and mixtures thereof; a dense, solid electrolyte adjacent to the porous, ceramic anode; a porous, ceramic cathode adjacent to the dense, solid electrolyte; and a dense, ceramic interconnect adjacent to the porous, ceramic cathode, wherein the dense, ceramic interconnect has nonintersecting passages for the flow of a fuel and an oxidant. Also disclosed is a method to make the SOFC having a catalytic anode.

6051330
SOLID OXIDE FUEL CELL HAVING VIAS AND A COMPOSITE INTERCONNECT

Benjamin V. Fasano, Kevin M. Prettyman, USA assigned to International Business Machines Corporation

One aspect of the invention relates to an interconnect for an SOFC wherein the interconnect is made from a cermet including partially stabilized tetragonal zirconia and a superalloy that is resistant to oxidizing and reducing conditions. Another aspect of the invention relates to an SOFC having vias for carrying fuel and an oxidant and at

least one patterned feature in the anode, electrolyte, cathode and/or interconnect for laterally distributing the fuel or oxidant.

6051331
FUEL CELL PLATELET SEPARATORS HAVING COORDINATE FEATURES

Reginald G. Spear Jr, H. Harry Mueggenburg, Rex Hodge, USA assigned to H Power Corporation

Fuel cell stacks comprising stacked separator/membrane electrode assembly fuel cells in which the separators comprise a series of thin sheet platelets, having individually configured serpentine micro-channel reactant gas humidification active areas and cooling fields therein. The individual platelets are stacked with coordinate features aligned in contact with adjacent platelets and bonded to form a monolithic separator. Post-bonding processing includes passivation, such as nitriding. Preferred platelet material is 4–25 mil Ti, in which the features, serpentine channels, tabs, lands, vias, manifolds and holes, are formed by chemical and laser etching, cutting, pressing or embossing, with combinations of depth and through etching preferred. The platelet manufacturing process is continuous and fast. By employing CAD based platelet design and photolithography, rapid change in feature design can accommodate a wide range of thermal management and humidification techniques. One hundred H_2–O_2/PEM fuel cell stacks of this IFMT platelet design will exhibit outputs on the order of 0.75 kW/kg, some three to six times greater than the current graphite plate PEM stacks.

6054228
FUEL CELL SYSTEM FOR LOW PRESSURE OPERATION

Alan J. Cisar, Dacong Weng, Oliver J. Murphy, USA assigned to Lynntech Inc.

This invention is an improved fuel cell design for use at low pressure. The invention has a reduced number of component parts to reduce fabrication costs, as well as a simpler design that permits the size of the system to be reduced at the same time as performance is being improved. In the present design, an adjacent anode and cathode pair are fabricated using a common conductive element, with that conductive element serving to conduct the current from one cell to the adjacent one. This produces a small and simple system suitable for operating with gas fuels or alternatively directly with liquid fuels, such as methanol, dimethoxymethane, or trimethoxymethane. The use of these liquid fuels permits the storage of more energy in less volume while at the same time eliminating the need for handling compressed gases which further simplifies the fuel cell system. The electrical power output of the design of this invention can be further increased by adding a passage for cooling the stack through contact with a coolant.

6054231
SOLID OXIDE FUEL CELL INTERCONNECTOR

Anil V. Virkar, Diane M. England, USA assigned to Gas Research Institute

A solid oxide fuel cell interconnector having a superalloy metallic layer with an anode facing face and a cathode facing face and a metal layer on the anode facing face of the superalloy metallic layer, the metal layer including a metal which reacts with Cr_2O_3 to form an electronically conducting oxide phase on the superalloy metallic layer. In accordance with one particularly preferred embodiment, a second metal layer is disposed between the metal layer and the superalloy metallic layer, the second metal layer including a metal which does not oxidize in a fuel atmosphere.

6054232
FUEL ELECTRODE FOR SOLID ELECTROLYTE FUEL CELLS AND A METHOD FOR MANUFACTURE OF THE ELECTRODE

Masamichi Ippommatsu, Minoru Suzuki, Hirokazu Sasaki, Shoji Otoshi, Hisao Ohnishi, Japan assigned to Osaka Gas Company Limited

The invention relates to a fuel electrode for high-temperature solid electrolyte fuel cells and a process for manufacture of the electrode. The fuel electrode of the invention is a porous element composed of a high-melting metal, such as ruthenium, osmium, rhodium or iridium, or an alloy containing the metal. The process for manufacture of the fuel electrode comprises coating an electrode material with a solution or dispersion of the high-melting metal and/or its chloride, sintering the same and finally reducing the product.

BATTERY MATERIALS

6045943
ELECTRODE ASSEMBLY FOR HIGH ENERGY DENSITY BATTERIES

Michael R. Nowaczyk, USA assigned to Wilson Greatbatch Ltd.

A flat-folded, multi-plate electrode assembly is described. The electrode assembly consists of anode and cathode electrodes in the form of continuous strips having extension plates which are first folded against their connection electrode portions to provide anode and cathode plate pairs. The anode and the cathode are then operatively associated with each other such that at least a portion of the anode strip is interleaved between corresponding ones of the cathode plate pairs and at least a portion of the cathode strip is interleaved between corresponding ones of the anode plate pairs. The

assembly is then 'Z' folded into the desired electrode stack. The extension plates of both electrodes insure electrode overlap in each and every fold, thereby optimizing electrode output. This design has the advantage of permitting the electrodes to be enlarged due to the electrode configuration and header connection, eliminates multiple components and insures matched electrode overlap.

6045947
ELECTRODE PLATE FOR SECONDARY BATTERY WITH NONAQUEOUS ELECTROLYTE AND METHOD OF MANUFACTURING THE SAME

Tadafumi Shindo, Yasushi Sato, Yuichi Miyazaki, Japan assigned to Dai Nippon Printing Company Ltd.

An electrode plate for a secondary battery with nonaqueous electrolyte comprises a collector and a coated layer formed on the collector by coating a coating solution at least containing an electrode active material and a binder on the collector and then drying the same, wherein a ratio (b/a) of an amount (b) of a binder existing at a boundary portion of the coated layer on a side opposite to a collector side to an amount (a) of a binder existing at a boundary portion of the coated layer contacting the collector is 0.05 or more and <2. The manufacturing method of the electrode plate comprises the step of forming a coated layer having a predetermined thickness by repeating at least two times of coating and drying processes for coating the coating solution, wherein a thickness of a coated layer formed in a second time or more than second time coating and drying processes is increased by an amount in a range 0.4–1.6 time of a thickness of a coated layer already formed in preceding coating and drying processes, or wherein an increased amount in weight per unit area of the coated layer formed in a second time or more than second time coating and drying processes is in a range 0.6–1.6 time of a weight per unit area of a coated layer already formed in preceding coating and drying processes.

6045951
NON-AQUEOUS ELECTROLYTE SYSTEM FOR USE IN BATTERIES, CAPACITORS OR ELECTROCHROMIC DEVICES AND A METHOD FOR THE PREPARATION THEREOF

Asa Wendsjo, Marine Consigny, Steen Yde-Andersen, Denmark assigned to Danionics A/S

A new non-aqueous electrolyte system for use in batteries, capacitors and electrochromic displays, and consisting essentially of an alkali or ammonium salt, a solvent mixture, and optionally a polymer is disclosed. The new system is characterized in that the solvent mixture comprises a mixture of ethylene carbonate (EC) and –valerolactone (–VL), optionally containing one or more additional solvents selected from other organic carbonates, other lactones, esters and glymes, said system optionally being confined a separator. The electrolyte system can be applied in a broad voltage range, has a conductivity $>10^{-3}$ S/cm at room temperature, and shows a high stability against reduction. The improved stability towards reduction is mirrored in a cycling efficiency which is superior to the cycling efficiency of known non-aqueous electrolyte systems.

6045952
ELECTROCHEMICAL STORAGE CELL CONTAINING A SUBSTITUTED ANISOLE OR DI-ANISOLE REDOX SHUTTLE ADDITIVE FOR OVERCHARGE PROTECTION AND SUITABLE FOR USE IN LIQUID ORGANIC AND SOLID POLYMER ELECTROLYTES

John B. Kerr, Minmin Tian, Japan assigned to the USA as represented by the US Department of Energy

A electrochemical cell is described comprising an anode, a cathode, a solid polymer electrolyte, and a redox shuttle additive to protect the cell against overcharging and a redox shuttle additive to protect the cell against overcharging selected from the group consisting of: (a) a substituted anisole having the general formula (in an uncharged state): (Figure) where R_1 is selected from the group consisting of H, OCH_3, OCH_2 CH_3, and OCH_2 phenyl, and R_2 is selected from the group consisting of OCH_3, OCH_2 CH_3, OCH_2 phenyl, and O^- Li^+; and (b) a di-anisole compound having the general formula (in an uncharged state): (Figure) where R is selected from the group consisting of $–OCH_3$ and $–CH_3$, *m* is either 1 or 0, *n* is either 1 or 0, and *X* is selected from the group consisting of $–OCH_3$ (methoxy) or its lithium salt — O^-Li^+. The lithium salt of the di-anisole is the preferred form of the redox shuttle additive because the shuttle anion will then initially have a single negative charge, it loses two electrons when it is oxidized at the cathode, and then moves toward the anode as a single positively charged species where it is then reduced to a single negatively charged species by gaining back two electrons.

6051335
NONCIRCULAR FIBER BATTERY SEPARATOR AND METHOD

Ann Dinh-Sybeldon, Thomas Danko, Jeffery Allen Oxley, USA assigned to Viskase Corporation

A battery separator of a nonwoven substrate coated on at least one surface with a cellulose film made from a liquid cellulose or cellulose derivative solution with the substrate having at least 50 wt.% noncellulosic fibers having a noncircular cross-sectional perimeter which has a percentage cross-sectional area difference relative to a circumscribed circle according to the formula: (Figure) wherein A is the area of a noncellulosic fiber cross-section, and B the area of a circle circumscribing said fiber cross-section and, prefer-

ably, having an absorption rate of at least 15, most preferably at least 30 mm/10 min in an aqueous solution of 40 wt.% KOH.

6054230
ION EXCHANGE AND ELECTRODE ASSEMBLY FOR AN ELECTROCHEMICAL CELL

Hiroshi Kato, Japan assigned to Japan Gore-Tex Inc.

This invention provides a solid polymer ion exchange membrane/electrode assembly, or an electrode/solid polymer ion exchange membrane/electrode assembly, for an electrochemical cell, which consists of planar layers of materials intimately joined together to form a unitary structure. The layers are joined together by solid polymer ion exchange resin present in at least one of each pair of adjacent layers. The unitary assembly can be used in an electrochemical cell such as a battery, electrolytic reactor, or fuel cell.

LITHIUM BATTERIES

6045594
METHOD OF MANUFACTURING NONAQUEOUS ELECTROLYTE BATTERY

Atsushi Yanai, Katsunori Yanagida, Yoshito Chikano, Ikuo Yonezu, Koji Nishio, Japan assigned to Sanyo Electric Company Ltd.

A method is disclosed for manufacturing a nonaqueous battery which includes a negative electrode containing lithium or a material capable of occluding and discharging lithium, a positive electrode containing an oxide of manganese or cobalt, and a nonaqueous electrolyte. In the method, the nonaqueous electrolyte is treated with an oxide of the metal of the positive electrode before the nonaqueous electrolyte is assembled into the battery. The method provides a nonaqueous electrolyte battery having an improved self-discharge property.

6045771
LITHIUM–NICKEL COMPLEX OXIDE, A PROCESS FOR PREPARING THE SAME AND A POSITIVE ELECTRODE ACTIVE MATERIAL FOR A SECONDARY BATTERY

Yukio Matsubara, Masami Ueda, Tadashi Fukami, Kazumi Fujimori, Tamaki Machi, Japan assigned to Fuji Chemical Industry Company Ltd.

There is provided a novel lithium nickel complex oxide represented by the general formula: wherein M represents one selected from the group consisting of Al, Fe, Co, Mn and Mg, $x = x_1 + x_2$, $0 < x_1 \leq 0.2$, $0 < x_2 \leq 0.5$, $0 < x \leq 0.5$, and $0.9 \leq y \leq 1.3$, and wherein the crystals have been sufficiently developed and are highly purified, and a positive electrode active material for a secondary battery whose stability of high discharge capacity is excellent.

6045939
LITHIUM SECONDARY BATTERY HAVING THERMAL SWITCH

Tatsuo Tateno, Genjiro Nishikata, Kenichiro Kami, Japan assigned to Sumitomo Chemical Company Ltd.

Provided is a lithium secondary battery comprising an electrode assembly which consists of a cathode, an anode and a separator laminated therebetween, and a battery case in which the electrode assembly is placed, said lithium secondary battery characterized by having a thermal switch which has a mechanism for electrically connecting the cathode and the anode at a portion other than an active material-contained layer in accordance with an increase in the battery temperature. The lithium secondary battery can prevent itself from being left in a charged condition after having an unusual trouble, and can operate the safety device even when its internal pressure decreases.

6045941
METHOD TO DETERMINE THE STATE OF CHARGE AND REMAINING LIFE OF LITHIUM BATTERIES USED IN OILFIELD SERVICES APPLICATIONS

Marvin Milewits, USA assigned to Schlumberger Technology Corporation

The present invention relates to a new method of constructing and interrogating electrochemical cells, especially those having lithium thionyl chloride ($Li/SOCl_2$) chemistry, that permits rapid estimation of remaining discharge capacity. A preferred embodiment of the present invention employs cells with specially modified anode structures and a method for testing the state of charge and remaining life of these cells, as well as depassivating these cells, prior to their intended use or re-use. The test method can be performed using an inexpensive DC circuit and voltmeter at ambient conditions anytime prior to cell use or re-use. There is also disclosed an oilfield services downhole tool battery having a remaining life indicator comprising a housing containing one or more electrochemical cells having an internal anode means which selectively gets consumed at a predetermined state of discharge thereby creating a step change in the cell output voltage which is imperceptible to the tool while in operation at downhole temperatures, and which is capable of being detected at the surface under ambient temperatures upon administering of a suitable current load enabling the user to determine the remaining battery life at the surface prior to subsequent use or reuse of the battery in downhole oilfield services operations.

6045945
ELECTROLYTE SOLUTION FOR LITHIUM SECONDARY BATTERY

Toshikazu Hamamoto, Atsuo Hitaka, Koji Abe, Yohsuke Ueno, Noriyuki Ohira, Masahiko Watanabe, Japan assigned to Ube Industries Ltd.

An electrolyte solution for a lithium secondary battery comprises a nonaqueous solvent and a fluorine-containing electrolyte capable of dissociating into lithium ions, wherein the content of HF in the electrolyte solution is <30 ppm.

6045948
ADDITIVES FOR IMPROVING CYCLE LIFE OF NON-AQUEOUS RECHARGEABLE LITHIUM BATTERIES

Yu Wang, Meijie Zhang, Ulrich von Sacken, Brian Michael Way, Canada assigned to NEC Moli Energy (Canada) Limited

The loss in delivered capacity (fade rate) after cycling non-aqueous rechargeable lithium batteries can be reduced by incorporating a small amount of an improved additive in the battery. Improved additives include boron trifluoride (BF_3), fluoboric acid (HBF_4), or complexes thereof. The invention is particularly suited to lithium ion batteries. Complexes comprising BF_3 and dietyl carbonate or ethyl methyl carbonate can be prepared which are particularly effective additives. Preferably, the additive is dissolved in the electrolyte.

6048372
METHOD OF PRODUCING AN ELECTRODE PLATE USED FOR A LITHIUM SECONDARY BATTERY AND A LITHIUM SECONDARY BATTERY

Toru Mangahara, Satoshi Tanno, Akira Takamuku, Masahiro Yamamoto, Tomoki Kourakata, Hiroki Ohto, Japan assigned to Furukawa Denchi Kabushiki Kaisha

A method of producing an electrode plate used for a lithium secondary battery and a lithium secondary battery containing such an electrode plate. The electrode plate is produced by coating a coating slurry of an active material mixture agent added with oxalic acid on a collector, drying and pressing, so as to obtain an electrode plate improved in charge–discharge cycle characteristics when used in a lithium secondary battery.

6048637
NONAQUEOUS SECONDARY BATTERY

Jiro Tsukahara, Masayuki Negoro, Koji Wariishi, Michio Ono, Japan assigned to Fuji Photo Film Company Ltd.

A nonaqueous secondary battery is disclosed, comprising a positive electrode, a negative electrode, and a nonaqueous electrolytic solution containing a lithium salt, wherein the battery contains a hydrazine derivative represented by formula (I): wherein R_1, R_2, and R_3 each represents an alkyl group, an aryl group, a heterocyclic group, an acyl group, an oxycarbonyl group or a sulfonyl group; and R_4 represents an acyl group, an oxycarbonyl group or a sulfonyl group.

6048643
PROCESS FOR PREPARING LITHIUM INTERCALATION COMPOUNDS

Max van Ghemen, Birgit Sauerbrey, Ludwig Pohl, Germany assigned to Merck Patent Gesellschaft

The invention relates to a process for preparing lithium intercalation compounds by thermal solid state reaction of mixtures of lithium hydroxide or lithium oxide and oxides or oxide precursors of transition metals. A significant step of this process is the treatment of an aqueous suspension of the raw material components lithium hydroxide or lithium oxide and metal oxide or metal oxide precursors with hydrogen peroxide, resulting in the lithium compound going into solution. In the drying of the mixture, the lithium hydroxide is very uniformly absorbed onto the metal oxide. Calcination at temperatures between 450 and 700°C results in complete reaction to form the lithium intercalation compound in <5 h.

6048645
METHOD OF PREPARING LITHIUM ION ELECTROCHEMICAL CELLS

Mohamed-Yazid Saidi, Jeffrey L. Swoyer, USA assigned to Valence Technology Inc.

In one embodiment, the invention provides a novel active material which is a lithium-rich, manganese oxide active material in the form of a single phase tetragonal crystal structured $Li_2\ Mn_2\ O_4$ compound having lattice parameters $a = b = 5.665 \pm 0.003$ Å, and $c = 9.265 \pm 0.003$ Å. A unique characteristic of the compound is that when lithium ions are deintercalated (extracted) from the $Li_2\ Mn_2\ O_4$ at first and second voltage plateaus, the crystal structure is transformed to a cubic structure characterized by lattice parameters $a = b = c = 8.235 \pm 0.004$ Å. On subsequent charge and discharge of the battery, corresponding to subsequent extraction and reinsertion of lithium into the electrode material at the second voltage plateau, the cubic structure is maintained.

6048646
METHOD FOR TREATING COPPER CURRENT COLLECTORS FOR LI-ION AND/OR LI-ION POLYMER BATTERIES

Xuekun Xing, Wan Jun Fang, James R. Winchester, III, USA assigned to GA-TEK Inc.

A method of treating a copper current collector (copper mesh and/or copper foil) for use in Li-ion and/or Li-ion polymer batteries, comprising the steps of: positioning a copper current collector within an electrolytic solution adjacent an anode plate, the electrolytic solution comprised of about 2–25 g/l of Cu_2^+, and about 30–100 g/l of $H_2 SO_4$; energizing the system to have a predetermined current density; maintaining the current density of the system for about 0.5–3.0 min; and removing the copper current collector from the electrolyte solution and rinsing the same.

6051339
LITHIATED POLYVANADATE CATHODES AND BATTERIES CONTAINING SUCH CATHODES

Dale R. Shackle, Benjamin Chaloner-Gill, USA assigned to Rentech Inc.

A cathode for use in an electrochemical cell comprising a lithiated isopolyvanadate or heteropolyvanadate wherein the isopolyvanadate or heteropolyvanate has a cage structure, and an electrochemical battery comprising an alkali metal anode, an ionically conductive electrolyte and a cathode which comprises a lithiated isopolyvanadate or heteropolyvanadate having a cage structure, are described.

6051340
RECHARGEABLE LITHIUM BATTERY

Soichiro Kawakami, Shinya Mishina, Naoya Kobayashi, Masaya Asao, Japan assigned to Canon Kabushiki Kaisha

A rechargeable lithium cell comprising an anode, a separator, a cathode, and an electrolyte or an electrolyte solution, characterized in that said anode comprises (a) a metal capable of being alloyed with lithium and (b) a metal incapable of being alloyed with lithium, said anode contains lithium when charging is operated, and wherein an anode terminal is extended from a portion formed of said metal (b).

6051342
LITHIUM ION SECONDARY BATTERY AND METHOD OF FABRICATING THEREOF

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In a lithium ion secondary battery which is composed of a positive electrode, a negative electrode and a separator which contains a Li ion-containing non-aqueous electrolytic solution, both of the ionic conductivity and adhesion strength were ensured by making an adhesive resin layer which bonds the positive electrode to the separator and the negative electrode to the separator into a mixture phase consisting of an electrolytic solution phase, an electrolytic solution-containing a polymer gel phase 10 and a polymer solid phase 11.

6051343
POLYMERIC SOLID ELECTROLYTE AND LITHIUM SECONDARY CELL USING THE SAME

Hisashi Suzuki, Satoshi Maruyama, Kazuhide Ohe, Japan assigned to TDK Corporation

To overcome the drawbacks of a P(VDF-HFP) system gel electrolyte and a cell using the same, a polymer having a vinylidene fluoride copolymer as a backbone and polyvinylidene fluoride in a side chain featuring good adhesion and exhibiting electro-chemical properties similar to the P(VDF-HFP) system without a crosslinking step is used as a binder for a gel electrolyte or electrode. The invention improves the adhesion of gel electrolyte to a current collector or electrode to reduce internal resistance; develops a polymeric solid electrolyte which is storage stable and capable of continuous lamination of coating layers; and provides an electrode which does not require an extra crosslinking step in assembly procedure, prevents positive and negative electrode materials from stripping off, and experiences a minimal capacitance drop upon repetitive charge/discharge cycles. A lithium secondary cell and an electric double-layer capacitor using the electrode is also described.

6053953
NONAQUEOUS SECONDARY BATTERY AND PROCESS FOR PREPARATION THEREOF

Hideki Tomiyama, Hiroshi Fujimoto, Hajime Miyamoto, Japan assigned to Fuji Photo film Company Ltd., Fujifilm Celltec Company Ltd.

A nonaqueous secondary battery is disclosed, comprising a positive electrode sheet containing a lithium-containing transition metal oxide as a positive electrode active material, a negative electrode sheet having at least one layer containing a negative electrode material capable of intercalating and deintercalating lithium, and a nonaqueous electrolyte containing a lithium metal salt, wherein the battery into which an electrolytic solution has been injected is sealed, subjected to charging treatment having at least two stages, and subjected to storage treatment having at least two steps. A process for preparing such the nonaqueous secondary battery is also disclosed.

6054110
PROCESS FOR PRODUCING LITHIUM–COBALT COMPOSITE OXIDE

Ryoji Yamada, Kenji Hashimoto, Shinichiro Ban, Japan assigned to Ise Kagaku Kogyo Kabushiki Kaisha Tokyo-to

A mixture of a cobalt compound and a lithium compound is calcined at a temperature of 250–1000°C, where said cobalt

compound has a cobalt content of 68.5 ± 6% by weight, its composition is substantially represented by a formula H_xCoO_y provided that $0 \leq x \leq 1.4$ and $1.3 \leq y \leq 2.2$, the half value width of a diffraction peak showing a maximum intensity in the neighborhood of $2\theta = 36-40^\circ$ in X-ray diffraction using Cu Kα as a radiation source is $>0.31^\circ$, and the relation between the cobalt content and the half value width is represented by the following formula: Half value width (degrees) $\geq 7.5–0.1 \times$ (Cobalt content) (wt.%). This provides an inexpensive and simple process for producing a lithium–cobalt composite oxide having uniform crystals, and a high-performance electrode active material for use in lithium secondary cells in high capacity and excellent in the charging–discharging cycle characteristics.

COMPONENTS AND/OR CHARGERS

6046573
SYSTEM FOR EQUALIZING THE LEVEL OF CHARGE IN BATTERIES

Bo Wikstrom, Sweden assigned to Xicon Battery Electronics AB

A system for equalizing the charge level of batteries comprising battery cells or battery blocks connected in series. Controlled voltage converters are on one side connected to a single or groups of battery cells or battery blocks and on another side connected to a common current path a positive conductor thereof being connected to a positive pole of the battery and the negative pole thereof being connected to a negative pole of the battery.

OTHER BATTERIES

6051038
METHOD FOR MAKING A HIGH RELIABILITY ELECTROCHEMICAL CELL AND ELECTRODE ASSEMBLY THEREFOR

William G. Howard, Roger W. Kelm, Douglas J. Weiss, Ann M. Crespi, Fred J. Berkowitz, Paul M. Skarstad, USA assigned to Medtronics Inc.

An electrochemical cell and electrode assembly in which an alkali metal anode and a cathode assembly are wound together in a unidirectional winding having substantially straight sides such that the winding will fit into a prismatic cell. The anode and cathode are arranged in the winding to provide for even utilization of reactive material during cell discharge by placing cathode and anode material in close proximity throughout the electrode assembly in the proportions in which they are utilized. The winding also contributes to even utilization of reactive material by employing multiple tabs on the cathode assembly to ensure that cathode material is evenly utilized throughout the electrode assembly during cell discharge and also so that connections to the tabs are readily made.

6051341
ORGANIC ELECTROLYTE BATTERY

Masanao Terasaki Japan assigned to Japan Storage Battery Company Ltd.

In an organic electrolyte battery, resistor layers having higher resisting values than those of electric conducting substrates retaining active material of an electrode are formed on the substrate surfaces.

FUEL CELL

6057051
MINIATURIZED FUEL CELL ASSEMBLY

Makoto Uchida, Yuko Fukuoka, Yasushi Sugawara, Nobuo Eda, Japan assigned to Matsushita Electric Industrial Company Ltd.

A miniaturized fuel cell assembly to power portable electronic equipment includes a hydride hydrogen storage unit, a control unit for controlling the flow of hydrogen, a hydrogen supply device interconnecting the hydrogen storage unit and the fuel cell body, and an air feed device to supply oxygen necessary for the generation of electricity. The fuel cell assembly may also have an air feed device to cool the interior of the equipment, including a water retention device for recovering and retaining water formed in the fuel cell body, and a humidifying device using the recovered water to humidify the hydrogen to be supplied to the fuel cell body. The miniaturized fuel cell assembly facilitates the effective transfer of waste heat from the fuel cell to the hydrogen storage unit, and as a result of its ability to be used repeatedly, can be utilized for a greater length of time than a conventional primary or secondary power cell.

6057053
COMPRESSION ASSEMBLY FOR AN ELECTROCHEMICAL FUEL CELL STACK

Peter Robert Gibb, Canada assigned to Ballard Power Systems Inc.

An electrochemical fuel cell stack comprises a first end plate, a second end plate, and fuel cell assemblies interposed between the first and second end plates. The stack further includes a compression assembly comprising a compression mechanism and a restraining mechanism. The compression mechanism urges the first end plate towards the second end plate applying an internal compressive force to the fuel cell assemblies, even as the thickness of the fuel cell assemblies changes. The restraining mechanism prevents movement of the first end plate away from the second end plate by preventing deflection of the compression mechanism, which may occur, for example, when internal fluid pressure is increased.