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## ***Patents ALERT***

This section contains abstracts of recently issued patents in the United States and published patent applications filed from over 100 countries under the Patent Cooperation Treaty and compiled in accordance with interest profiles developed by the Editors.

***Journal of Power Sources***

*LEAD-ACID***6524747****CATALYST EQUIPPED VAPOR-COMMUNICATING  
MULTI-CELL VALVE REGULATED  
LEAD-ACID BATTERY**

Leslie S. Holden; Sudhan S. Misra; Terrence M. Noveske; USA assigned to CandD Charter Holdings Inc.

A recombinant lead-acid battery comprising a plurality of lead-acid cells in a case including apertured partitions defining space for vapor migration among cells and comprising a catalyst unit communicating with said vapor migration space and enhancing recombination of hydrogen and oxygen.

**6531248****BATTERY PASTE**

George C. Zguris; Antonio L. Ferreira; USA assigned to Squannacook Technologies LLC

A battery paste is disclosed. One such paste consists essentially of at least one lead oxide (i.e., an uncalcined oxide of lead) and at least one lead oxide sulfate, sufficient water to moisten the paste, and from 0.02 to 15% based on the weight of the lead oxide plus the weight of the lead oxide sulfate, calculated as the lead oxide, of glass fibers having an average diameter not greater than 15  $\mu\text{m}$ . Another paste consists essentially of at least one lead oxide and at least one lead oxide sulfate, sufficient water to moisten the paste, and from 1 to 15% based on the weight of the lead oxide plus the weight of the lead oxide sulfate, calculated as the lead oxide, of glass fibers of a specific composition that enables specific beneficial ions to diffuse into the paste during the life of the battery. A method for producing such a battery paste and a delivery system for adding the additives that are added into the paste is also disclosed. The method comprises charging a part of the water and a part of the special composition glass fibers desired in the paste to a mechanical mixer, mixing the water and fibers, adding the lead oxide or oxides desired in the paste to the mixer, mixing the water, glass fibers and lead oxide or oxides until essentially all of the free water in the mixer has been mixed with the lead oxide or oxides, adding the rest of the water required to moisten the paste to the desired consistency and the sulfuric acid required to form the lead oxide sulfate or sulfates, and mixing the paste. The delivery system is the charging to a paste batch of a glass fiber mat that has been impregnated with the other required additives in such a proportion that a certain size/weight of the mat provides all the additional ingredients.

**6533862****PASTING MACHINE FOR AN ACTIVE  
PASTE FOR A LEAD BATTERY**

Shinichi Kokaji; Naohiro Otake; Japan assigned to The Furukawa Battery Company Ltd.

A pasting machine is provided for paste of an active material for a lead battery which is capable of continuously applying stably and favorably, not only a paste of active material for a negative electrode, but also a paste of active material for a positive electrode, to a continuous substrate. There is arranged within a hopper 1 a pair of front and rear paddles 2:2 located above, a delivery roller 3 located below, a vaned roller 5' located at a rear side of the intermediate portion, and an auxiliary roller 4 located diagonally to the upper front of the delivery roller 3 spaced from and opposed to the delivery roller 3. A delivery opening 6a of an orifice plate 61 fixed to the lower end of the hopper 1 is made open to direct paste in the same direction as the travel direction of a continuous, substrate A.

**6534212****HIGH PERFORMANCE BATTERY AND  
CURRENT COLLECTOR THEREFOR**

John W. Hooke; USA assigned to Hawker Energy Products Inc.

A winding assembly for a battery includes a positive electrode plate, a negative electrode plate, a separator sheet, and a current collector. The positive and negative plates and the separator sheet are wound in overlying relationship such that the separator sheet is positioned between the positive and negative plates, an exposed top edge of the positive electrode plate is spaced longitudinally from an adjacent unexposed top edge of the negative plate, and an exposed bottom edge of the negative electrode plate is spaced longitudinally from an unexposed bottom edge of said positive electrode plate. The current collector is connected to one of the exposed edges of one of the positive and negative electrode plates, and, accordingly, is spaced apart from the adjacent unexposed bottom edge of the other (i.e., the non-attached) electrode plate. The current collector includes a terminal mounting portion and a radially extending collecting web. The collecting web of the current collector includes a perimeter, at least one open-ended perimeter aperture located at the perimeter and extending radially inwardly therefrom, and at least one closed-end internal aperture positioned between the terminal portion and the perimeter. Also, the current collector may have recessed areas surrounding the apertures to facilitate joining of the current collector and the electrode plate.

**BATTERY MATERIALS****6533964****POLYMER, BINDER RESIN, COMPOSITION FOR IONICALLY CONDUCTIVE POLYMER ELECTROLYTE, AND SECONDARY BATTERY**

Kimiyo Hata; Takaya Sato; Japan assigned to Nisshinbo Industries Inc.

The invention provides a novel polymeric compound comprising polyvinyl alcohol units and having an average degree of polymerization of at least 20, in which some or all of the hydroxyl groups on the polyvinyl alcohol units are substituted with oxyalkylene-containing groups to an average molar substitution of at least 0.3; a binder resin composed of this polymeric compound; an ion-conductive polymer electrolyte composition having a high ionic conductivity and high tackiness which lends itself well to use as a solid polymer electrolyte in film-type cells and related applications; and a secondary cell.

**6534218****ELECTRODE FOR NON-AQUEOUS ELECTROLYTE BATTERY**

Mikio Okada; Hideo Yasuda; Japan assigned to Japan Storage Battery Company Ltd.

The following aspects (1)–(4) of the present invention can provide an electrode for a non-aqueous electrolyte battery having excellent safety and charged storage properties and good high rate charge–discharge properties. (1) An electrode for non-aqueous electrolyte battery comprising a particulate active material having a porous film formed thereon. (2) An electrode for non-aqueous electrolyte battery comprising an active material having a filler held in pores. (3) An electrode for non-aqueous electrolyte battery comprising an active material which undergoes volumetric expansion and shrinkage during charge–discharge, having a filler held in pores. (4) The electrode for a non-aqueous electrolyte battery according to embodiment (1), wherein said porous film is an ionically-conductive film.

**6537334****POLYMERIC MESOPOROUS SEPARATOR ELEMENTS FOR LAMINATED LITHIUM-ION RECHARGEABLE BATTERIES**

Aurelien DuPasquier; Jean-Marie Tarascon; France assigned to Valence Technology Inc.

A mesoporous polymeric membrane for use as an ionically-conductive inter-electrode separator in a rechargeable battery cell is prepared from a coatable composition comprising a polymeric material, a volatile fluid solvent for the poly-

meric material, and a second fluid miscible with and of lesser volatility than the solvent, the second fluid being a nonsolvent exhibiting no significant solvency for the polymeric material. A layer is cast from the composition to form a layer which is gelled and solidified to a self-supporting membrane by volatilizing the solvent and nonsolvent coating vehicle fluids under conditions in which the solvent volatilizes at a rate substantially faster than that of the nonsolvent.

**6537468****COMPOSITION FOR IONICALLY CONDUCTIVE SOLID POLYMER, IONICALLY CONDUCTIVE SOLID POLYELECTROLYTE, BINDER RESIN, AND SECONDARY BATTERY**

Kimiyo Hata; Takaya Sato; Japan assigned to Nisshinbo Industries Inc.

The invention is directed at an ion-conductive solid polymer-forming composition, a binder resin and an ion-conductive solid polymer electrolyte comprising (A) a polymeric compound containing polyvinyl alcohol units and having an average degree of polymerization of at least 20, in which compound some or all of the hydroxyl groups on the polyvinyl alcohol units are substituted with oxyalkylene-containing groups to an average molar substitution of at least 0.3; (B) an ion-conductive salt; and (C) a compound having crosslinkable functional groups. The composition and the polymer electrolyte obtained therefrom have a high ionic conductivity and a high tackiness. Moreover, the polymer electrolyte has a semi-interpenetrating polymer network structure, giving it excellent shape retention.

**6537696****NONWOVEN SEPARATOR FOR A NICKEL-METAL HYDRIDE BATTERY**

J. Kevin Whear; Joseph G. Yaritz; USA assigned to Daramic Inc.

The preferred embodiment is to a battery separator for a nickel metal hydride (NiMH) battery. The separator includes a wetttable, resilient nonwoven web having two spunbond layers sandwiching a melt blown layer. The web has a puncture strength of greater than 6 N, a tensile strength of greater than 200 N/m, and an average pore size of less than 20  $\mu\text{m}$ .

**6541158****COBALT-BASED ALLOYS AS POSITIVE ELECTRODE CURRENT COLLECTORS IN NON-AQUEOUS ELECTROCHEMICAL CELLS**

Christine A. Frysz; Sally Ann Smesko; Peter A. Kreidler; W. Richard Brown; Esther S. Takeuchi; USA assigned to Wilson Greatbatch Ltd.

Cobalt-based alloys are provided for use as a positive electrode current collector in a solid cathode, non-aqueous liquid electrolyte, alkali metal anode active electrochemical cell. The cobalt-based alloys are characterized by chemical compatibility with aggressive cell environments, high corrosion resistance and resistance to fluorination and passivation at elevated temperatures, thus improving the longevity and performance of the electrochemical cell. The cell can be of either a primary or a secondary configuration.

**6541160**

**BATTERY SEPARATOR WITH  
SULFIDE-CONTAINING INORGANIC SALT**

Michael Cheiky; Wilson Hago; USA assigned to Zinc Matrix Power Inc.

A battery separator for use in a zinc-based battery containing sulfide ions is employed to minimize copper ion diffusion into the electrodes by placing a regenerated cellulose separator next to the copper-containing layer containing low solubility sulfide salts and precipitating the copper ions.

**6541161**

**LITHIUM ION CONDUCTING CHANNEL VIA  
MOLECULAR SELF-ASSEMBLY**

Lawrence G. Scanlon Jr.; USA assigned to the United States of America as represented by the Secretary of the Air Force

An electrolyte for an electrochemical cell consisting of a di-lithium phthalocyanine.

*FUEL CELL*

**6531236**

**POLYMER ELECTROLYTE FUEL CELL STACK**

Kazuhito Hatoh; Eiichi Yasumoto; Kazufumi Nishida; Hisaaki Gyoten; Teruhisa Kanbara; Hideo Ohara; Makoto Uchida; Yasushi Sugawara; Toshihiro Matsumoto; Japan assigned to Matsushita Electric Industrial Company Ltd.

The present invention provides a polymer electrolyte fuel cell stack that includes a cell laminate having a plurality of unit cells, which are laid one upon another and each of which includes a polymer electrolyte membrane, a pair of electrodes that are arranged across the polymer electrolyte membrane and respectively have a catalytic reaction layer, a separator having means for feeding a supply of fuel gas containing hydrogen gas to one of the electrodes, and another separator having means for feeding a supply of oxidant gas to the other of the electrodes. In the polymer electrolyte fuel cell stack, a sealing portion is disposed at least in the vicinity of each electrode. The polymer electrolyte fuel cell stack of the present invention has excellent durability and productivity. Gasket sealing portions, a sealing portion for cooling water, and sealing portions for water and gas in an

internal humidifying unit are constituted by a polymer compound that has polyisobutylene as the backbone structure. This arrangement ensures the high reliability.

**6531237**

**MANIFOLD AND SEALING ASSEMBLY  
FOR FUEL CELL STACK**

Dana A. Kelley; Richard P. Hayes; USA assigned to FuelCell Energy Inc.

A manifold and manifold sealing assembly for use with a fuel cell stack having a plurality of faces in which the assembly includes a plurality of frame assemblies and a plurality of manifolds, and at least one frame assembly adjacent a given face of the fuel cell stack provides support for a part of the frame assembly abutting the face of the stack adjacent the one face. Additionally, the manifold abutting the one frame assembly and the manifold abutting the supported frame assembly are adapted to sealingly engage in the area of support.

**6531239**

**BIOLOGICAL FUEL CELL AND METHODS**

Adam Heller; USA assigned to TheraSense Inc.

A fuel cell has an anode and a cathode with anode enzyme disposed on the anode and cathode enzyme is disposed on the cathode. The anode is configured and arranged to electrooxidize an anode reductant in the presence of the anode enzyme. Likewise, the cathode is configured and arranged to electroreduce a cathode oxidant in the presence of the cathode enzyme. In addition, anode redox hydrogel may be disposed on the anode to transduce a current between the anode and the anode enzyme and cathode redox hydrogel may be disposed on the cathode to transduce a current between the cathode and the cathode enzyme.

**6531245**

**FUEL CELL, SEPARATOR FOR THE SAME  
AND METHOD FOR DISTRIBUTING  
GAS IN FUEL CELL**

Seiji Mizuno; Tsuyoshi Takahashi; Mikio Wada; Japan assigned to Toyota Jidosha Kabushiki Kaisha

Separators for unit cells of a fuel cell each have a plurality of through holes extending therethrough and a recessed portion formed in a surface thereof. In a fuel cell incorporating such separators, the recessed portion of each separator forms an in-cell oxidative gas passage, together with an adjacent cathode. An oxidative gas, supplied from an external device into the fuel cell, is distributed from an oxidative gas supply manifold formed by holes of the separators, to the in-cell oxidative gas passages. The oxidative gas is then collected in an oxidative gas discharge manifold formed by holes of

the separators, and conveyed out of the fuel cell by the discharge manifold. During the passage through each in-cell oxidative gas passage, the oxidative gas flows via an oxidative gas transit manifold formed by holes of the separators.

**6534209**

**METHOD AND DEVICE FOR FILLING  
A FUEL CELL STACK**

Karl-Heinz Hauer; Germany assigned to Volkswagen AG

The present invention relates to an improved fuel cell stack comprising a plurality of fuel cells connected in series and method for operation so that portions of the stack can be switched to parallel operation in response to an actuating signal by means of supplemental gas-intake ports having closable valves and optionally supplemental gas-exhaust ports having closable valves.

**6534210**

**AUXILIARY CONVECTIVE FUEL CELL  
STACKS FOR FUEL CELL POWER  
GENERATION SYSTEMS**

Richard Eric Luken; Pam Dawson; Robert Mohan; Vijay K. Garg; Prabhakar Singh; USA assigned to Visteon Global Technologies Inc.

A fuel cell power generation system is disclosed which includes a primary fuel cell stack for generating a first quantity of electric power, an auxiliary fuel cell stack for generating a second quantity of electric power, a fuel handling subsystem for feeding a fuel containing hydrogen to the primary fuel cell stack and the auxiliary fuel cell stack, an oxidant handling subsystem including a compressor for feeding an oxidant containing oxygen to the primary fuel cell stack, and a controller electrically connected to the primary fuel cell stack, the auxiliary fuel cell stack, the fuel handling subsystem and the oxidant handling subsystem for controlling operation of the fuel cell power generation system. In one version of the fuel cell power generation system, the controller executes a stored program to sense a startup signal for the fuel cell power generation system, to initiate operation of the auxiliary fuel cell stack, and to apply at least a portion of the second quantity of electric power generated by the auxiliary fuel cell stack to the oxidant handling subsystem to initiate operation of the primary fuel cell stack.

**6534211**

**FUEL CELL HAVING AN AIR ELECTRODE WITH  
DECREASED SHRINKAGE AND INCREASED  
CONDUCTIVITY**

Hiroshi Tsukuda; Nagao Hisatome; Yoshiharu Watanabe; Tohru Houjyou; Japan assigned to Mitsubishi Heavy Industries Ltd.

A full cell comprising a fuel electrode and an air electrode disposed on side surfaces of an electrolyte film is disclosed. The fuel electrode is supplied with a fuel gas, and the air electrode is supplied with air. The air electrode has a close-packed structure in which the ratio between the average particle size of coarse particles and the average particular size of fine particles is from 5/1 to 250/1. The resulting fuel cell is increased in conductivity.

**6536262**

**DETERMINATION OF THE ALCOHOL  
CONCENTRATION IN THE ELECTROLYTE OF  
FUEL CELLS**

Manfred Baldauf; Walter Preidel; Germany assigned to Siemens Aktiengesellschaft

In a method for determining the alcohol concentration in the alcohol/water mixture of fuel cells that are operated with this mixture, in particular for direct methanol fuel cells, the alcohol/water mixture is pumped through a constriction. The differential pressure between the entry to and exit from the constriction and, if appropriate, the flow velocity of the mixture through the constriction are measured, and the alcohol concentration is determined therefrom.

**6537691**

**CONTAINER FOR RECEIVING AN OPERATING  
MEANS FOR THE OPERATION OF FUEL CELLS**

Thomas Poschmann; Detlef Zur Megede; Germany assigned to Ballard Power Systems AG

A container for receiving an operating medium for the operation of fuel cells has an inlet for a medium, a first outlet and a second outlet. The container is divided by at least one permeable component into at least an inlet-side interior space, and an interior space which is remote from the inlet. The first outlet is arranged in the inlet-side interior space and the second outlet is arranged in the interior space which is remote from the inlet.

**6537692**

**FUEL CELL APPARATUS**

Munehisa Horiguchi; Kenji Kato; Japan assigned to Kabushikikaisha Equos Research

The present invention provides a direct water injection type fuel cell apparatus which can effectively cool an air electrode in a fuel cell main body. The apparatus supplies water to the surface of the air electrode in a liquid state and the amount of process air supplied to the air electrode is controlled to an optimum.

**6541141****WATER RECOVERY IN THE ANODE SIDE OF A PROTON EXCHANGE MEMBRANE FUEL CELL**

David Frank; Xuesong Chen; Canada assigned to Hydrogenics Corporation

A fuel cell has a proton exchange membrane. In known manner, the fuel cell includes inlets and outlets for flow of an oxidant and for flow of a fuel gas, commonly hydrogen. To deal with the issue of humidification, the invention provides a recirculation conduit including a pump connected between the anode inlet and the anode outlet. A water separator is provided in the recirculation conduit, for separating water from fuel gas exiting the anode. A main fuel inlet is connected to the recirculation conduit, for supply of fuel. A branch conduit can be provided, to enable purge cycles and other options to be provided.

**6541142****FUEL CELL SYSTEM HAVING A METHANOL DECOMPOSITION REACTOR**

Paul Taichiang Yu; William Henry Pettit; Gerald Voecks; USA assigned to General Motors Corporation

A fuel cell system having a methanol decomposition reactor that is used to solve cold startup and transient operating condition problems. Methanol is charged into a methanol decomposition reactor and heat is supplied to decompose methanol (an endothermic reaction) and to produce hydrogen molecules and carbon monoxide. Hot exhaust gas (effluent) from the methanol decomposition reactor is charged to a steam reformer to preheat the reformer. The hydrogen produced by methanol decomposition is used by a fuel cell stack.

**6541144****FUEL CELL SYSTEM**

Hisaaki Gyoten; Hiroki Kusakabe; Eiichi Yasumoto; Osamu Sakai; Japan assigned to Matsushita Electric Industrial Company Ltd.

A fuel cell system includes a first electrolyte-electrode assembly which comprises a hydrogen ion-conductive electrolyte layer, and a fuel electrode and a hydrogen-generating electrode that sandwich the electrolyte layer; a second electrolyte-electrode assembly which comprises a hydrogen ion-conductive electrolyte layer, and a fuel electrode and an oxidant electrode that sandwich the electrolyte layer; a fuel supplying means for supplying a liquid or gas fuel to the fuel electrode of the first electrolyte-electrode assembly; a means for applying to the fuel electrode of the first electrolyte-electrode assembly a potential which is positive to the hydrogen-generating electrode; and a

means for supplying to the fuel electrode of the second electrolyte-electrode assembly hydrogen generated in the hydrogen-generating electrode.

**6541145****FLOW FIELDS FOR SUPPORTING FLUID DIFFUSION LAYERS IN FUEL CELLS**

David Pentreath Wilkinson; Olen R. Vanderleeden; Joerg Zimmerman; Canada assigned to Ballard Power Systems Inc.

An improved flow field design for a flow field plate comprises fluid distribution channels having an average width  $W$  and separated by landings in which the channels are configured such that unsupported rectangular surfaces of length  $L$  and width  $W$  on an adjacent fluid diffusion layer have a ratio  $L/W$  less than about 3. Improved support may be obtained for instance by using sinusoidally shaped channels. Certain fluid diffusion layer embodiments offer desirable characteristics (for example, low cost, thickness) for use in fuel cells but may also be undesirably weak mechanically and consequently will benefit from improved mechanical support from adjacent flow field plates comprising the present flow field design.

**6541147****PRINTED CIRCUIT BOARD SEPARATOR FOR AN ELECTROCHEMICAL FUEL CELL**

Gerard Francis McLean; Jeremy Lindstrom; Canada assigned to Ballard Power Systems Inc.

A proton exchange membrane (PEM)-type fuel cell is formed from layered undulate MEA structures and separator plates alternating with each other in the stack dimension so that each layered MEA structure is disposed between and attached to an associated pair of separator plates so as to form at least one discrete conduit on each side of each layered MEA structure through which conduit reactant gas may be circulated. Each layered MEA structure is formed from proton exchange membrane material sandwiched between a pair of spaced-apart current collectors with electro-catalyst particles between the membrane material and each current collector so that the membrane material and electro-catalyst particles fill the space between the current collectors, forming together with the current collectors a layered MEA structure. Each separator plate is formed from a non-conductive substrate overlaid on each surface by a selected pattern of conductive paths, paths on one side of the substrate being connected by vias to paths on the other side of the substrate, the paths being attached to the current collectors of the layered MEA structures on either side of the separator plate.

**6541148****MANIFOLD SYSTEM FOR A FUEL CELL STACK**

Michael M. Walsh; James H. Kralick; Daniel F. Woolley; USA assigned to Plug Power Inc.

A fuel cell system includes a fuel cell stack, a manifold and a hinge. The manifold forms a sealed interface to communicate reactants with the stack, and the hinge forms a pivotable connection between the stack and the manifold. The fuel cell system also includes at least one gas/water separator that is disposed in the manifold to collect water from one of the flows.

**6541150****SOLID POLYMER ELECTROLYTE FUEL CELL**

Gang Xie; Harumi Hashiguchi; Norio Nakaya; Atsushi Tomita; Japan assigned to Aisin Seiki Kabushiki Kaisha

In order to improve gas permeability and electric conductivity, a solid polymer electrolyte fuel cell is so designed as to include an electrolyte 100 in the boom of an ion exchange membrane, a gas diffusion layer 110/120 arranged on each side of the electrolyte 100, and an electrode catalyst substance, dispersed in the gas diffusion layer 110/120.

**6541941****FUEL CELL MANAGER**

William Adams; Christopher L. Gardner; James H. Dunn; Canada assigned to Estco Battery Management Inc.

A controller controls a switch bank which can shunt a voltage source in parallel with one or more fuel cells in a stack. By controlling the voltage of the voltage source, the current through the fuel cells is directly controlled. By increasing the anode potential of the fuel cell through control of the voltage source, poisons deposited on the electrocatalyst are removed, thereby rejuvenating the fuel cells. Fuel cells in a stack can be treated in turn, causing a reduction of the effects of electrocatalyst poison on stack performance.

*LITHIUM BATTERIES***6534214****LITHIUM SECONDARY CELL**

Motoaki Nishijima; Takehito Mitate; Kazuo Yamada; Naoto Nishimura; Naoto Torata; Japan assigned to Sharp Kabushiki Kaisha

A lithium secondary battery includes a positive electrode containing a first solid electrolyte; a negative electrode containing a second solid electrolyte; and a layer of a third solid electrolyte between the positive and negative electrodes.

**6534217****POSITIVE ELECTRODE MATERIAL AND SECONDARY BATTERY USING THE SAME**

Keizou Koga; Yosuke Hosoya; Junji Kuyama; Masayuki Nagamine; Japan assigned to Sony Corporation

Disclosed is a positive electrode material having improved charging/discharging cycle characteristic, shelf stability, and discharge load characteristic, and a secondary battery using the material. A rolled electrode body obtained by rolling strip-shaped positive and negative electrodes with a separator inbetween is provided on the inside of a battery can. The separator is impregnated with an electrolytic solution. The positive electrode contains a positive electrode material in which a coating portion is provided on the surface of a center portion made of a lithium composite oxide such as  $\text{LiMn}_2\text{O}_4$ . The coating portion is made of a conductive oxide such as ITO (indium tin oxide) or  $\text{SnO}_2$ . The quantity of the coating portion is 0.001–0.1/mol of the center portion. By the technique, while assuring conductivity, elution of the positive electrode material into the electrolytic solution can be suppressed and a reaction product can be prevented from being deposited on the surface of the positive electrode.

**6537697****LITHIUM SECONDARY BATTERY**

Yoshinori Kida; Katsunori Yanagida; Atsushi Yanai; Atsuhiko Funahashi; Toshiyuki Nohma; Ikuo Yonezu; Japan assigned to Sanyo Electric Company Ltd.

The lithium secondary battery of this invention uses a non-aqueous electrolyte including lithium tetrakis(pentafluorophenyl)borate as a part or whole of an electrolytic salt. As a result, the lithium secondary battery exhibits better charge–discharge cycle performance than a lithium secondary battery using a conventional lithium salt as the electrolytic salt.

**6537698****ELECTROCHEMICAL CELL HAVING AN ELECTRODE WITH A PHOSPHONATE ADDITIVE IN THE ELECTRODE ACTIVE MIXTURE**

Hong Gan; Esther S. Takeuchi; USA assigned to Wilson Greatbatch Ltd.

An electrochemical cell of either a primary or a secondary chemistry, is described. In either case, the cell has a negative electrode of lithium or of an anode material which is capable of intercalating and de-intercalating lithium coupled with a positive electrode of a cathode active material. A phosphonate compound is mixed with either the anode material or the cathode active material prior to contact with its current collector. The resulting electrode couple is activated by a non-aqueous electrolyte. The electrolyte flows into and

throughout the electrodes causing the phosphonate additive to dissolve in the electrolyte. The phosphonate solute is then able to contact the lithium to provide an electrically insulating and ionically conducting passivation layer thereon.

**6537701**

**COATED LITHIUM ELECTRODES**

Yevgeniy S. Nimon; May-Ying Chu; Steven J. Visco; USA assigned to PolyPlus Battery Company Inc.

Batteries including a lithium anode stabilized with a metal-lithium alloy and battery cells comprising such anodes are provided. In one embodiment, an electrochemical cell having an anode and a sulfur electrode including at least one of elemental sulfur, lithium sulfide, and a lithium polysulfide is provided. The anode includes a lithium core and an aluminum-lithium alloy layer over the lithium core. In another embodiment, a surface coating, which is effective to increase cycle life and storageability of the electrochemical cell, is formed on the anode. In a more particular embodiment, the anode is in an electrolyte solution, and, more particularly, an electrolyte solution including either elemental sulfur, a sulfide, or a polysulfide where the surface coating is composed of  $Al_2S_3$ .

**6537703**

**POLYMERIC MESOPOROUS SEPARATOR ELEMENTS FOR LAMINATED LITHIUM-ION RECHARGEABLE BATTERIES**

Aurelien DuPasquier; Jean-Marie Tarascon; France assigned to Valence Technology Inc.

A mesoporous polymeric membrane for use as an ionically-conductive inter-electrode separator in a rechargeable battery cell contains a like distribution of mesopore voids throughout a membrane matrix. The porous membrane is capable of absorbing significant amounts of electrolyte solution to provide suitable ionic conductivity for use in rechargeable battery cells. The addition of inert particulate filler to the coating composition provides further strength in the body of the membrane and provides particulate support within the membrane mesopores which prevents collapse of the voids at cell fabrication laminating temperatures and thus maintains electrolyte absorption capability.

**6537705**

**LITHIUM ION SECONDARY BATTERY AND ITS MANUFACTURE**

Kouji Hamano; Hisashi Shiota; Yasuhiro Yoshida; Michio Murai; Takayuki Inuzuka; Shigeru Aihara; Sho Shiraga; Japan assigned to Mitsubishi Denki Kabushiki Kaisha

A secondary lithium ion battery, comprising a plurality of laminates each having a separator holding an electrolytic

solution to which a positive electrode and a negative electrode are joined with an adhesive resin layer having a mixed phase composed of an electrolytic solution phase, a polymer gel phase containing an electrolytic solution, and a polymer solid phase.

**6541140**

**ELECTROCHEMICAL LITHIUM ION SECONDARY CELL HAVING MULTIPLATE ELECTRODES WITH DIFFERING DISCHARGE RATE REGIONS**

David M. Spillman; Esther S. Takeuchi; USA assigned to Wilson Greatbatch Technologies Inc.

A secondary electrochemical cell comprising a medium rate electrode region intended to be discharged under a substantially constant drain and a high rate electrode region intended to be pulse discharged, is described. Both electrode regions share a common anode and are activated with the same electrolyte.

**6541156**

**NEGATIVE ELECTRODE MATERIAL FOR NON-AQUEOUS LITHIUM SECONDARY BATTERY, METHOD FOR MANUFACTURING THE SAME, AND NON-AQUEOUS LITHIUM SECONDARY BATTERY USING THE SAME**

Tooru Fuse; Hideharu Satou; Keiko Nishioka; Shinji Kasamatsu; Yoshiaki Nitta; Japan assigned to Mitsubishi Chemical Corporation, Matsushita Electric Industrial

The present invention relates to a negative electrode material for a non-aqueous lithium secondary battery comprising a metal material M consisting of solid phases A and B, a graphite material, and a carbonaceous material having a crystallinity lower than that of said graphite material, wherein said metal material M has a structure in which a part or all of the surface of a core particle consisting of said solid phase A is covered with said solid phase B; said solid phase A contains at least silicon as a constitutive element; and said solid phase B is a solid solution or an intermetallic compound of silicon and a specific element.

**6541162**

**ELECTROLYTE FOR RECHARGEABLE LITHIUM BATTERY AND RECHARGEABLE LITHIUM BATTERY COMPRISING THE SAME**

Eui-Hwan Song; Sergey V. Sazhin; Mikhail Yu Khimchenko; Yevgeniy N. Tritenichenko; South Korea assigned to Samsung SDI Company Ltd.

An electrolyte for a rechargeable lithium battery is provided. The electrolyte includes a non-aqueous organic solvent and a lithium salt. The non-aqueous organic solvent includes cyclic carbonate such as ethylene carbonate and propylene



carbonate, chain carbonate such as dimethyl carbonate, diethyl carbonate, methyl ethyl carbonate and methyl propyl carbonate, and alkyl acetate such as *n*-methyl acetate, *n*-ethyl acetate and *n*-propyl acetate. The electrolyte can be used in a rechargeable lithium battery to provide good low temperature characteristics and safety.

#### *NICKEL METAL HYDRIDE BATTERIES*

**6541146**

#### **COMPOSITE SEALANT MATERIALS BASED ON REACTING FILLERS FOR SOLID OXIDE FUEL CELLS**

Liang A. Xue; James Piascik; Jean Yamanis; USA assigned to Hybrid Power Generation Systems LLC

A composite sealant for in situ sealing a fuel cell stack is provided. A paste of the sealant mixture is initially formed by mixing a glass precursor powder and a reacting filler material. The sealant mixture paste is applied to selected sealing locations of the fuel cell stack. The sealant mixture paste is then transformed into a composite sealant material to seal the selected sealing locations by heat treatment in air to about 900 °C. The composite sealant material comprises a glass matrix phase and a reinforcing phase including a plurality of interlocked elongated single crystal grains. The reacting fillers modify the CTE and significantly improve the gap filling capacity of the composite sealant material and provide superior pressure containment capability at elevated temperatures.

#### *COMPONENTS AND/OR CHARGERS*

**6534954**

#### **METHOD AND APPARATUS FOR A BATTERY STATE OF CHARGE ESTIMATOR**

Gregory L. Plett; USA assigned to Compact Power Inc.

The present invention relates to an implementation of a battery state of charge (SOC) estimator for any battery type. It addresses the problems associated with the existing implementations such as high error uncertainty, limited application (i.e., only one battery type) and susceptibility to temperature changes. Embodiments of the present invention use Kalman filter or Extended Kalman filter for a battery model that has SOC as an internal system state. Having an SOC internal state allows the invention to provide an uncertainty associated with its SOC estimation. One embodiment does not take battery temperature as a parameter in its SOC estimation. Another embodiment uses battery temperature as a parameter to adjust its SOC estimation to keep the accuracy of the SOC estimation from being affected by changing temperature. One embodiment allows different modeling parameters during battery operation to accommodate highly dynamic

batteries used in Hybrid Electric Vehicles and Electric Vehicles.

**6534957**

#### **CHARGING METHOD FOR CHARGING NON-AQUEOUS ELECTROLYTE SECONDARY BATTERY**

Mashio Shibuya; Tomitaro Hara; Yusuke Suzuki; Akinori Kita; Japan assigned to Sony Corporation

An initial charging operation is carried out by a charging step composed of two-stages or more to improve an initial charging and discharging efficiency, reduce the charge of wasteful materials and improve a high capacity and a high cyclic characteristic without deteriorating various kinds of battery properties. In order to realize the improvements, a non-aqueous solvent which is decomposed under a potential higher than the reduction and decomposition potential of a main solvent is included in electrolyte. This charging method is a method for achieving the addition effect of such a non-aqueous solvent as much as possible. As a specific means, the electrolyte to which vinylene carbonate is added is employed and a constant-current and constant-voltage charge under about 3.2 V is carried out for 1 to 2 h before a battery is completely charged. Thus, a good coat can be formed on the surface of an anode while suppressing the quantity of electricity required for forming the coat.

#### *OTHER BATTERIES*

**6521373**

#### **FLAT NON-AQUEOUS ELECTROLYTE SECONDARY CELL**

Masami Suzuki; Muneto Hayami; Kazuo Udagawa; Kazuo Iizuka; Naomi Ishihara; Satoshi Hirahara; Hirotaka Sakai; Kiyoto Yoda; Masataka Shikota; Japan assigned to Toshiba Battery Company Ltd.

In a flat non-aqueous electrolyte secondary cell comprising an electricity-generating element including at least a cathode, a separator and an anode and a non-aqueous electrolyte in the inside of a cathode case, a plurality of electrode units each consisting of the cathode and the anode opposite to each another via the separator are laminated to form an electrode group, or an electrode unit in a sheet form consisting of the cathode and the anode opposite to each another via the separator is wound to form an electrode group, or a sheet-shape cathode is wrapped with the separator except for a part contacting at inner face of cathode case and a sheet-shaped anode is set on the sheet-shaped cathode in a right angled position each other and then these cathode and anode are bent alternately to form an electrode group, and the total sum of the areas of the opposing cathode and anode in this electrode group is larger than the area of the opening of an insulating gasket in a sealed portion in the cathode

case or than the area of an opening in a sealed plate in a sealed portion in the cathode case, whereby the discharge capacity upon heavy-loading discharge is significantly increased as compared with the conventional cells. Accordingly, while the size of the cell is small, the discharge capacity is increased as described above, and thus it is possible to provide a highly utilizable flat non-aqueous electrolyte secondary cell. Further, in said flat non-aqueous electrolyte secondary cell, problems which may be caused by the increased discharge capacity in the cell can be solved by improving the solvent and supporting electrolyte for the electrolyte or by various improvements in the cathode and anode cases.

**6522103**

**SODIUM-SULFUR BATTERY SYSTEM AND DRIVING METHOD THEREOF**

Tadahiko Miyoshi; Manabu Madokoro; Japan assigned to Hitachi Ltd.

There are provided a sodium-sulfur battery system suitable for shifting the peak of an electric power line, and a method of operating the sodium-sulfur battery system and an electric power line system using the sodium-sulfur battery system. In a sodium-sulfur battery system comprising a battery module having a sodium-sulfur battery contained in a thermal insulation container, an amount of peak-shift of an electric power line, which can be performed by the battery module, is calculated using a daily load characteristic of the electric power line and a discharge characteristic of the battery module, and an allowable amount of heat generation in battery and an allowable amount of discharge, and discharge of the battery module is controlled using the calculated result. The peak-shift of an electric power line can be effectively performed without deteriorating the reliability of the sodium-sulfur battery, and the efficiencies of the sodium-sulfur battery system and an electric power line system using the sodium-sulfur battery system can be kept high.

**6524452**

**ELECTROCHEMICAL CELL**

Duncan Guy Clark; Stephen Hampden Joseph; Herbert Stephen Oates; Great Britain assigned to Regenesys Technologies Limited

A flow-frame for forming a subassembly; said sub-assembly comprising a bipolar electrode and an ion-selective membrane mounted on said flow-frame and wherein said sub-assembly may be stacked together with other such subassemblies to create an array of electrochemical cells; wherein said flow-frame is formed from an electrically insu-

lating material and comprises at least four manifold-defining portions which also define pathways for the passage of the anolyte/catholyte. Such pathway may define a labyrinthine path which may be spiral in shape between the manifold and the chamber entry/exit port.

**6524734**

**AIRFLOW SYSTEM OF METAL-AIR BATTERY**

Jong Woong Jeon; South Korea assigned to Icelltech Corporation

The present invention is relates in a metal-air battery, which called coin cell generally, having a cathode in the container wherein anode top filled with electrolyte is placed with gasket in between. In this battery structure, air chamber is provided between the cathode and cathode container, and cathode is being abutted by embossed polarity mark to maximize a gas diffusion passage from a port to peripheries of cathode providing clearance of air chamber between peripheries of cathode container and cathode. This air passage provides sufficient and rapid airflow makes a cell operate at maximum performance and extend cell lifetime.

**6535373**

**NON-AQUEOUS ELECTROLYTE**

W. Novis Smith; Joel McCloskey; USA assigned to Lithdyne International

A non-aqueous electrolyte for use in batteries and electrical capacitors for use at low temperatures. The electrolyte consists of at least two quaternary ammonium salts in a nitrile solvent.

**6541157**

**NON-AQUEOUS ELECTROLYTE BATTERY HAVING LARGE CAPACITY AND LONG CYCLE LIFE**

Hiroki Inagaki; Norio Takami; Tatsuoki Kohno; Tomokazu Morita; Japan assigned to Kabushiki Kaisha Toshiba

It is intended to provide a non-aqueous electrolyte battery that satisfies both of a large discharge capacity and a superior cycle life characteristic by developing a novel negative electrode material. A non-aqueous electrolyte battery uses a negative electrode active material that is a compound expressed by formula (1), where A is at least one element selected from the alkali metals, M is at least one element selected from the group consisting of Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Ru, Rh, Pd, Os, Ir, Pt, and Mg, X is at least one element selected from the group consisting of B, N, Al, Si, P, Ga, Ge, As, In, Sn, Sb, Pb, and Bi, 0 ≤ z ≤ 20, and 0.2 ≤ y ≤ 6.