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Journal of Power Sources 117 (2003) 283–292



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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***6479966****METHOD AND APPARATUS FOR RECONDITIONING A BATTERY**

Tai-An Chiang; Arthur Chenghsin Wu; Taiwan Assigned to Tachiang Technology Corporation

A method and apparatus for reconditioning and charging a battery is disclosed. The lead-acid battery rejuvenator apparatus comprises of an oscillator, a frequency divider and a pair of transistors. The oscillator outputs a frequency signal. The frequency divider receives the frequency signal and splits the frequency signal into a plurality of non-overlapping operating frequency signals. These operating frequency signals are sent to respective operating frequency output terminals. The three terminals of a first transistor are electrically connected to one terminal of an inductor, the negative terminal of the lead-acid battery and one of the operating frequency output terminals. The other terminal of the inductor is electrically connected to the negative terminal of the lead-acid battery. The three terminals of a second transistor are electrically connected to one terminal of a resistor, the negative terminal of the lead-acid battery and another operating frequency output terminal. The other terminal of the resistor is electrically connected to the positive terminal of the lead-acid battery.

*FUEL CELL***6468681****FUEL CELL SYSTEM**

Munehisa Horiguchi; Japan assigned to Kabushikikaisha Equos Research

A fuel cell system has a plurality of fuel cells each having a cathode and an anode disposed on opposite sides of an electrolyte membrane, having an air supply passage through which atmospheric air is supplied to the cathode. A fuel gas supply passage supplies hydrogen gas from a hydrogen storing alloy to the anode; and water spray nozzles spray liquid water directly onto the cathode. The hydrogen storing alloy is heated by heat exchange with the exhaust air at an elevated temperature discharged from the cathode, to facilitate its endothermic reaction in which it produces hydrogen gas to be supplied to the anode. The sprayed water is fed to the hydrogen storing alloy so as to cool the same to thereby enhance its exothermic reaction in which hydrogen gas is stored in the hydrogen storing alloy.

**6468682****ION EXCHANGE MEMBRANE FUEL CELL**

William A. Fuglevand; Peter D. DeVries; Glen Alden Lloyd; David R. Lott; John P. Scartozzi; USA assigned to Avista Laboratories Inc.

An ion exchange membrane fuel cell is described and which includes a module enclosing a membrane electrode diffusion assembly which has an active area defined by a surface area, and which produces an average current density of at least about  $350 \text{ mA cm}^{-2}$  of surface area when supplied with a dilute fuel at a nominal voltage of about 0.5 V.

**6468685****SEPARATOR FOR A FUEL CELL**

Tsunemori Yoshida; Japan assigned to Nippon Pillar Packing Company Ltd.

In a separator for a fuel cell according to the invention, a separator is formed by molding a bondcarbon compound in which a composition ratio of graphite powder is set to 60–90%, and a composition ratio of a thermosetting resin is set to 10–40%, and at least a top end face of each of the number of ribs contacting the surface of an anode or a cathode is coated with a conductive film made of a material which is lower in specific resistance than the bondcarbon compound. According to this configuration, while excellent moldability and high productivity are ensured by the use of the bondcarbon compound containing a larger content of a resin, the contact resistance with respect to an electrode is lowered so that the conductivity of the whole can be improved, and predetermined performance of a fuel cell can be surely exerted.

**6468686****FLUID PERMEABLE FLEXIBLE GRAPHITE FUEL CELL ELECTRODE WITH ENHANCED ELECTRICAL AND THERMAL CONDUCTIVITY**

Robert Angelo Mercuri; Thomas William Weber; Michael Lee Wardrip; USA assigned to Graftech Inc.

A membrane electrode assembly is provided comprising a pair of electrodes and an ion exchange membrane positioned between the electrodes, at least one of the electrodes being formed of a sheet of a compressed mass of expanded graphite particles having a plurality of transverse fluid channels passing through the sheet between first and second opposed surfaces of the sheet, one of opposed surfaces abutting said ion exchange membrane, said transverse fluid channels being formed by mechanically impacting an opposed surface of the sheet to displace graphite within the sheet at predetermined locations.

**6471195****HUMIDIFIER FOR USE WITH A FUEL CELL**

Hiroshi Shimanuki; Toshikatsu Katagiri; Motohiro Suzuki; Yoshio Kusano; Japan assigned to Honda Giken Kogyo Kabushiki Kaisha

A humidifier for use with a fuel cell, including a plurality of combined water permeable membranes or water permeable devices, each of the water permeable membranes or water permeable devices generating humidified gas by flowing

therein different gases with different moisture contents and by moisture exchanging between the different gases so that one dry gas with smaller moisture content is humidified with the other moist gas with larger moisture content; and flowing passage switching devices Va for optionally switching flowing passages Ca of the dry gas. The flowing passage switching devices Va switches the flowing passage Ca in accordance with a required amount of the humidified gas so as to selectively use particular water permeable membranes or a particular water permeable device 21 from among the plurality of water permeable membranes or water permeable devices.

**6472091**

**FUEL CELL SYSTEM AND METHOD FOR SUPPLYING ELECTRIC POWER IN A MOTOR VEHICLE**

Gerhard Konrad; Josef Zieger; Arnold Lamm; Wolfgang Von Schwerin; Karl-Ernst Noreikat; Germany assigned to DaimlerChrysler AG

A fuel cell system and method for supplying electrical devices with electric energy in a vehicle wherein, to increase the efficiency of the power generation, the fuel cell system is supplied with atmospheric oxygen from the compressed air system. Additionally, a compressed air reservoir or a compressor for ambient air is provided in order to supply the fuel cell system with atmospheric oxygen.

**6472095**

**HYBRID FUEL CELL REACTANT FLOW FIELDS**

Paul R. Margiott; USA assigned to UTC Fuel Cells, LLC

A fuel cell reactant flow field has flow-through channels joined by an interface with inter-digitized flow channels. The interface may be defined by a flow reversing manifold or may exist between flow reversing manifolds, remotely thereof.

**6475249**

**METHOD FOR MANUFACTURING MEMBRANE ELECTRODE ASSEMBLY OF FUEL CELL**

Cheng Hsien Hsu; Chi Chao Wan; Yaw Chung Cheung; Yingjeng James Li; Taiwan assigned to Industrial Technology Research Institute

A method for manufacturing a membrane electrode assembly of a fuel cell by solvent pretreatment to the electrolyte membrane of the membrane electrode assembly is disclosed. A prepared electrolyte membrane is soaked in alcohol solvent for pre-expanding the electrolyte membrane at first, a catalyst layer is uniformly coated onto at least one side of the pre-expanded electrolyte membrane, and then the electrolyte membrane is dried for evenly shrinking the electrolyte membrane and the catalyst layer. Finally, the electrolyte membrane with catalyst layers is interposed between two gas diffusion electrodes, and the resulting sheet is pressed with heating to form the membrane electrode assembly.

**6475376**

**MILD HYDROTREATING/EXTRACTION PROCESS FOR LOW SULFUR FUEL FOR USE IN FUEL CELLS**

Lawrence W. Jossens; Curtis L. Munson; Gunther H. Dieckmann; USA assigned to Chevron USA Inc.

A two step sulfur removal for treatment of hydrocarbonaceous fuel intended for use in a fuel cell comprising a mild hydrotreating step followed by an extraction step reduces the sulfur content in fuel to 5 ppm total sulfur or less and a fuel processor suitable for carrying out the process.

**6478078**

**HEAT EXCHANGER FOR COOLING CIRCULATING WATER OF FUEL CELLS AND PROCESS FOR PRODUCING SAME**

Tsutomu Matsuzaki; Yoshihiro Sasaki; Chizuko Yoshida; Japan assigned to Calsonic Kansei Corporation

The invention relates to a heat exchanger for cooling a circulating water of a fuel cell. This heat exchanger includes (1) an aluminum member having an inner surface which defines an inner space in the aluminum member such that the circulating water is allowed to flow through the inner space; and (2) a resin coating layer formed on the inner surface of the aluminum member. It becomes possible to prevent contamination of the circulating water by the provision of the resin coating layer. The heat exchanger can be produced by a first process including (a) providing a core portion having tubes made of aluminum and corrugated fins, which are alternately arranged; (b) assembling the core portion and a tank made of aluminum into an assembly; (c) brazing the assembly by heating into a brazed assembly; and (d) coating the inner surface of the brazed assembly with a resin coating layer.

**6479178**

**DIRECT HYDROCARBON FUEL CELLS**

Scott A. Barnett; USA assigned to Northwestern University

The direct electrochemical oxidation of hydrocarbons in solid oxide fuel cells, to generate greater power densities at lower temperatures without carbon deposition. The performance obtained is comparable to that of fuel cells used for hydrogen, and is achieved by using novel anode composites at low operating temperatures. Such solid oxide fuel cells, regardless of fuel source or operation, can be configured advantageously using the structural geometries of this invention.

**6479182**

**FUEL CELL ELECTRODE ASSEMBLY WITH SELECTIVE CATALYST LOADING**

Robert Angelo Mercuri; USA assigned to Graftech Inc.

A membrane electrode assembly is provided. More particularly, an assembly is provided which includes a pair of

electrodes and an ion exchange membrane having opposed major surfaces positioned between the electrodes, at least one of the electrodes being formed of a sheet of a compressed mass of expanded graphite particles having a plurality of transverse fluid channels passing through the sheet between first and second opposed surfaces of the sheet, one of opposed surfaces abutting the ion exchange membrane. At least one of the surfaces of the ion exchange membrane has a catalyst metal selectively loaded thereon.

**6482763**

**SUBOXIDE FUEL CELL CATALYST FOR ENHANCED REFORMATE TOLERANCE**

Gregory M. Haugen; Mark K. Debe; John H. Thomas, III; Krzysztof A. Lewinski; George D. Vernstrom; USA assigned to 3M Innovative Properties Company

The present invention provides fuel cell electrode catalysts comprising alternating platinum-containing layers and layers containing sub-oxides of a second metal, where the catalyst demonstrates an early onset of CO oxidation. Preferred second metals are selected from the group consisting of Group IIIb metals, Group IVb metals, Group Vb metals, Group VIb metals and Group VIIb metals, most preferably Ti, Ta, W and Mo. The present invention additionally provides methods of making such catalysts, preferably by alternate deposition of platinum and second metals in the presence of sub-stoichiometric amounts of gaseous oxygen.

*BATTERY MATERIALS*

**6468697**

**COMPOSITE POLYMER ELECTROLYTES CONTAINING ELECTRICALLY NON-CONDUCTIVE CHOPPED FIBERS**

George R. Ferment; Joseph B. Kejha; USA assigned to Lithium Technology Corporation

Composite polymer electrolytes for use in alkali-metal-based electrochemical devices, which electrolytes contain chopped electrically non-conductive fibers in an electrolyte slurry which has been cured on a release tape and then pressed onto an electrode, or slurry which is coated directly onto said electrode, and then cured.

**6469107**

**ION-CONDUCTIVE POLYMER ELECTROLYTE COMPOSITION OF POLYGLYCIDOL**

Takaya Sato; Japan assigned to Nissihinbo Industries Inc.

An ion-conductive polymer electrolyte composition comprising a polymeric polyol such as polyglycidol or a derivative thereof, an ion-conductive salt and a cross-linkable functional group-bearing compound is used to prepare an ion-conductive solid polymer electrolyte having a high ionic

conductivity and a semi-interpenetrating polymer network structure.

**6472104**

**SOLID HYBRID POLYMER ELECTROLYTES**

Ralph Ulrich; Josef W. Zwanziger; Susan de Paul; Hans Wolfgang Spiess; Ulrich Wiesner; Germany

The invention relates to a process for preparing a solid organic-inorganic hybrid polymer electrolyte containing lithium ions. The product shows high strength conductivity and lithium transference values. Further, the product can be self-organized into nanometer scale plates and rods paving the way to making lithium conducting cables, for example; and hence, batteries of nanometer size.

**6475554**

**METHOD OF PRODUCING ELECTRODE OF NON-AQUEOUS ELECTROLYTE BATTERY**

Daisuke Nakazato; Japan assigned to TDK Corporation

A method for industrial and simplified production of an electrode for a non-aqueous electrolyte battery without unfavorable peeling of the electrode coating layer is provided. An electrode for a non-aqueous electrolyte battery is produced by mixing an electrode active material with a binder to prepare an electrode coating-material, applying the electrode coating-material onto an electrode collector, drying the electrode having the coating layer formed, and then carrying out aging for not less than 18 h before or after compression-molding. The aging is preferably carried out for not less than 24 h.

**6478987**

**PROTON CONDUCTING POLYMER, METHOD FOR PRODUCING THE SAME, SOLID POLYMER ELECTROLYTE AND ELECTRODE**

Hiroshi Akita; Masao Ichikawa; Masaru Iguchi; Hiroyuki Oyanagi; Japan assigned to Honda Giken Kogyo Kabushiki Kaisha

A proton conducting polymer obtained by blending an organic phosphoric acid compound solution with a meta-type polyaniline solution; a solid polymer electrolyte for a fuel cell comprising the proton conducting polymer, which is excellent in proton conductivity, methanol barrier property and dopant stability in an aqueous solution of methanol; and an electrode comprising the proton conducting and fine catalyst particles carried on porous particles.

**6479181**

**CLASS OF ELECTROCATALYSTS AND A GAS DIFFUSION ELECTRODE BASED THEREON FOR FUEL CELLS**

Gennadi Finkelshtain; Yuri Katzman; Mikhail Khidekel; Israel assigned to Medis El Ltd.

An electrocatalyst based on a highly electroconducting polymer and a transition metal, in which transition metal atoms are covalently bonded to heteroatoms of the backbone monomers of the polymer. The covalently bonded transition metal atoms are nucleation sites for catalytically active transition metal particles. The complex is prepared by complexing a highly electroconducting polymer with transition metal coordination ions and then reducing the transition metal ions to neutral atoms. An electrode for a fuel cell is made by impregnating an electrically conducting sheet with the catalytic complex and drying the impregnated sheet. The scope of the present invention includes such electrodes and the fuel cells that incorporate these electrodes.

6479183

**BASE MATERIAL FOR A FUEL BATTERY**

Hiroshi Tsukuda; Toshiro Nishi; Nagao Hisatome; Toru Houjyou; Japan assigned to Mitsubishi Heavy Industries Ltd.

A material for a base tube of a fuel battery, comprising a mixture of at least two components selected from the group consisting CaO, ZrO<sub>2</sub>, NiO, MgO, SrO, Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, and BaO. Such material suppresses cracks of an electrolyte and also suppresses leakage after rapid temperature increase and decrease, thus providing a reliable fuel battery.

6482539

**ELECTROCHEMICAL CELL WITH SINTERED ANODE OF METALLIC PARTICLES AND OXIDES**

Franciscus Petrus Felix Van Berkel; Gerardus Simon Schipper; Jan Peter De Jong; The Netherlands assigned to Stichting Energieonderzoek Centrum Nederland

An anode for an electrochemical cell having an oxide-to-metal particle size ratio gradient between the current collector side and the electrolyte side of the anode.

*LITHIUM BATTERIES*

6468692

**LITHIUM SECONDARY BATTERY WITH SEALED CASING MEMBERS**

Hiroshi Nemoto; Shinji Ohtubo; Toshihiro Yoshida; Japan assigned to NGK Insulators Ltd.

A lithium secondary battery contains an electrode body obtained by winding a positive electrode and a negative electrode via a separator, a non-aqueous electrolytic solution, and a battery case accommodating the electrode body and the non-aqueous electrolytic solution. A lid and a metal foil are adhered to each other with a resin to form a pressure-releasing valve and make air-tight the inside of the battery case. This secondary battery is easy to produce and has excellent operational safety and excellent reliability.

6468698

**LITHIUM ION SECONDARY BATTERY AND METHOD OF FABRICATING THE SAME**

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

To provide a practical thin type lithium ion secondary battery having a excellent safety and charge-discharge properties. A lithium ion secondary battery comprising a positive electrode 1, a negative electrode 4, a separator 7 retaining an electrolytic solution, and an adhesive resin layer 8 which connects said positive electrode 1 and negative electrode 4 to said separator 7, characterized in that said adhesive resin layer 8 comprises a polyvinylidene fluoride and an ionically conducting polymer compound incorporated therein.

6479191

**ELECTROLYTE HAVING ALKYNE DERIVATIVE AND LITHIUM SECONDARY BATTERY USING THE SAME**

Toshikazu Hamamoto; Koji Abe; Tsutomu Takai; Yasuo Matsumori; Akikazu Ito; Japan assigned to Ube Industries Ltd.

An electrolyte for a lithium secondary battery comprising (i) a non-aqueous solvent, especially consists essentially of a high dielectric solvent and a low viscosity solvent, and (ii) an electrolyte salt, dissolved therein and (iii) an alkyne derivative or an alkyne carbonate derivative and also a lithium secondary battery using the same are disclosed.

6479192

**NON-AQUEOUS ELECTROLYTE FOR ELECTROCHEMICAL SYSTEMS AND LITHIUM SECONDARY BATTERY COMPRISING THE SAME**

Geun-Chang Chung; Song-Hui Jun; Hyeong-Jin Kim; South Korea assigned to LG Chemical Ltd.

A non-aqueous electrolyte lithium secondary battery that includes: a carbon capable of intercalating and de-intercalating lithium ion as an anode; a lithium containing material that can reversibly intercalate and de-intercalate lithium ion as a cathode; and a non-aqueous electrolyte including *trans*-4,5, dialkyl-1,3-dioxolane-2-one substantially free of *cis*-4,5-dialkyl-1,3-dioxolane-2-one and a lithium salt.

6479426

**NEGATIVE ACTIVE MATERIAL FOR LITHIUM SECONDARY BATTERY**

Jae-Yul Ryu; Sang-Young Yoon; Wan-Uk Choi; Kyou-Yoon Sheem; Sang-Jin Kim; South Korea assigned to Samsung SDI Company Ltd.

Disclosed is a negative active material for a lithium secondary battery. The negative active material includes graphitized

coke having a graphitization catalyst element and non-flat artificial graphite. The negative active material for a lithium secondary battery has good electrolyte-immersibility due to the gap between the graphite particles from graphitized coke having a graphitization catalyst element, and non-flat artificial graphite. Therefore, the present invention may provide a lithium secondary battery which has good high-rate capacity and initial efficiency.

**6482374**

**METHODS FOR PRODUCING LITHIUM METAL OXIDE PARTICLES**

Sujeet Kumar; Hariklia Dris Reitz; Craig R. Horne; James T. Gardner; Ronald J. Mosso; Xiangxin Bi; USA assigned to NanoGram Corporation

Lithium manganese oxide particles have been produced with an average diameter less than about 250 nm. The particles have a high degree of uniformity. The particles can be formed by the heat treatment of nanoparticles of manganese oxide. Alternatively, crystalline lithium manganese oxide particles can be formed directly by laser pyrolysis. The lithium manganese oxide particles are useful as active materials in the positive electrodes of lithium-based batteries. Improved batteries result from the use of uniform nanoscale lithium manganese oxide particles.

**6482548**

**LITHIUM-ALUMINUM DUAL-CATION RECHARGEABLE ELECTROCHEMICAL BATTERY CELL**

Glenn G. Amatucci; USA assigned to Telcordia Technologies Inc.

A rechargeable battery cell having high operating voltage and significantly increased specific capacity comprises a positive electrode member, a negative electrode member, and an interposed separator member containing an electrolyte comprising a solution of a polyvalent aluminum cation solute in a non-aqueous solvent. The positive electrode member comprises an active material which reversibly takes up and releases the reactive polyvalent cation species during operation of the cell while the active material of the negative electrode contemporaneously reversibly releases into and takes up from the electrolyte solvent a monovalent cation species. Preferred cation species are those of aluminum, such as  $Al^{3+}$ , and alkali metals, such as  $Li^+$ .

**6482549**

**RECHARGEABLE LITHIUM BATTERY**

Seiji Yoshimura; Takashi Okamoto; Shin Fujitani; Japan assigned to Sanyo Electric Company Ltd.

A rechargeable lithium battery includes a negative electrode containing lithium as an active material, a positive electrode containing a lithium-manganese complex oxide as an active

material and a non-aqueous liquid electrolyte containing a solvent, a solute and trialkyl phosphite.

**6482550**

**NON-AQUEOUS SECONDARY BATTERY**

Naoki Imachi, Watanabe; Hiroshi, Narukawa; Satoshi; Japan assigned to Sanyo Electric Company Ltd.

A non-aqueous secondary battery comprising a negative electrode made of an active negative electrode material capable of intercalating/deintercalating lithium ion, a positive electrode made of spinel type lithium manganese oxide as a main active positive electrode material and an electrolyte containing a non-aqueous solvent is characterized in that said positive electrode comprises lithium cobalt oxide in admixture with spinel type lithium manganese oxide having crystal lattices partially substituted by magnesium or aluminum and said non-aqueous solvent comprises vinylene carbonate incorporated therein.

*NICKEL/HYDRIDE BATTERIES*

**6471890**

**METHOD FOR PRODUCING A POSITIVE ELECTRODE ACTIVE MATERIAL FOR AN ALKALINE STORAGE BATTERY**

Futoshi Tanigawa; Yasushi Nakamura; Yoshitaka Dansui; Kohji Yuasa; Japan assigned to Matsushita Electrical Industrial Company Ltd.

The method for producing a positive electrode active material for an alkaline storage battery is disclosed. The method includes a first oxidation treatment of a raw material powder comprising a nickel hydroxide solid solution and cobalt hydroxide to oxidize the cobalt hydroxide to a cobalt oxyhydroxide; and a second oxidation treatment of the powder obtained in the first oxidation treatment to oxidize the nickel hydroxide solid solution to a nickel oxyhydroxide solid solution.

**6472101**

**NICKEL-HYDROGEN STORAGE BATTERY**

Reizo Maeda; Katsuhiko Shinyama; Yoshinori Matsuura; Mitsuzo Nogami; Ikuo Yonezu; Koji Nishio; Japan assigned to Sanyo Electric Company Ltd.

In a nickel-metal hydride storage cell, deterioration of a cell capacity at high temperature and degradation of a cycle characteristic are suppressed. The nickel-metal hydride storage cell of the invention comprises in a cell case, a positive electrode comprising a positive electrode active material composed mainly of nickel hydroxide powder, a negative electrode comprising a negative electrode active material composed mainly of hydrogen-absorbing alloy powder, and a separator interposed between the positive

and negative electrodes and impregnated with an electrolyte, the nickel-metal hydride storage cell characterized in that the negative electrode active material comprises a copper compound, the positive electrode comprises an aggregate of coated particles each in which a coating layer comprising a sodium-containing cobalt compound is formed on a surface of a nickel hydroxide particle, and the positive electrode active material is such that an oxide or hydroxide of one of bismuth, calcium, ytterbium, manganese, copper, scandium, and zirconium, is added to the aggregate of coated particles.

**6479189**

**SEALED ALKALINE STORAGE BATTERY  
WITH A MANGANESE CONTAINING  
NiOH ELECTRODE**

Takeshi Ogasawara; Yoshifumi Magari; Nobuyuki Higashiyama; Mamoru Kimoto; Yasuhiko Itoh; Japan assigned to Sanyo Electric Company Ltd.

The sealed alkaline storage battery of this invention includes a non-sintered nickel positive electrode using, as an active material, manganese-containing a-nickel hydroxide including, as a solid-solution element, 15–50 wt.% of manganese on the basis of a total amount of nickel and manganese; a negative electrode; and an alkaline electrolyte including 0.55–0.80 g of water per gram of the manganese-containing a-nickel hydroxide. In this manner, the invention provides an alkaline storage battery exhibiting high positive electrode active material utilization for a large number of charge-discharge cycles.

*CHARGERS AND/OR COMPONENTS*

**6469471**

**BATTERY CHARGE MEASUREMENT AND  
DISCHARGE RESERVE TIME PREDICTION  
TECHNIQUE AND APPARATUS**

Adnan H. Anbuky; Phillip E. Pascoe; New Zealand assigned to Invensys Energy Systems (NZ) Limited.

A method of testing one or more cells and parameterising the results in order to obtain a characteristic curve/function from which cell discharge reserve time can be predicted from cell voltage. The test involves obtaining a plurality of data points representing the voltage of a cell as a function of charge remaining, and parameterising the data points to obtain a function representing cell voltage and charge remaining. The function allows charge remaining to be calculated from cell voltage. The invention also provides for a device for measuring capacity and predicting discharge reserve time of a cell, the device including a voltage and current measuring means adapted to measure the voltage and load current of a cell. The device also includes a timing means so that a number of voltage and current data points can be obtained

with respect of time. The data points are parameterised and the device produces a function relating charge remaining to cell voltage whereby the charge remaining can be determined by measuring the cell voltage.

**6469473**

**METHOD AND APPARATUS FOR USING PULSE  
CURRENT TO EXTEND THE FUNCTIONALITY  
OF A BATTERY**

Michael Schlicht; USA assigned to Battery Performance Technologies Inc.

A method to extend the functionality of a battery, the method comprising drawing power from the battery, and repetitively drawing a current pulse greater than the minimum conditioning current from the battery, thereby conditioning the battery.

**6469512**

**SYSTEM AND METHOD FOR DETERMINING  
BATTERY STATE-OF-HEALTH**

Harmohan Singh; Thirumalai G. Palanisamy; Richard B. Huykman; William C. Hovey; USA assigned to Honeywell International Inc.

A system and method for accurate and in real time determination of factors relating to the state of health of a storage battery. The system measures the values of battery temperature, voltage and current flow into and out of the battery. This data is multiplexed into a computer and the battery's internal resistance (IR), polarization resistance (PR), state of charge (SOC) and its cold cranking amp (CCA) capability are computed and displayed. The presence of shorted and mismatched cells also can be determined and displayed. The state of health of the battery is related to these displayed measured values and calculated factors which are made known to the user of the battery.

**6479962**

**IN-DEVICE CHARGING SYSTEM AND METHOD  
FOR MULTI-CHEMISTRY BATTERY SYSTEMS**

Ted B. Ziemkowski; Heather N. Bean; Mark J. Bianchi; USA assigned to Hewlett-Packard Company

A battery management system and method for an electronic device that may be powered by an ac source (using an ac adapter), or by a battery. The battery management system includes firmware configured to determine whether a battery coupled to the electronic device is rechargeable. The firmware is also coupled to and configured to control a charge switch. When the battery and an ac source are both coupled to the device, activating the charge switch causes a charging current to be applied from the ac source to the battery. The charge switch and firmware are configured to cause the charging current to not be applied to the battery if it is determined that the battery is not rechargeable.

6479967

**METHOD OF CONTROLLING THE  
DISCHARGING OF A SECONDARY STORAGE  
CELL BATTERY**

Thierry Berleureau; France assigned to Alcatel

A method of controlling the discharging of a battery including a plurality of modules each consisting of at least one secondary storage cell includes the following steps: (a) a voltage  $V_z(t_n)$  of each module  $z$  and a discharge current  $I(t_n)$  are measured synchronously at time  $t_n$ , (b) the internal resistance  $IR_z(t_n)$  of each module  $z$  is calculated as follows:  $IR_z(t_n) = V_z(t_n)/I(t_n)$ , (c) a voltage  $V_z(t_{n+1})$  of each module  $z$  and a discharge current  $I(t_{n+1})$  are measured synchronously at time  $t_{n+1}$ , (d) the internal resistance  $IR_z(t_{n+1})$  of each module  $z$  is calculated as follows:  $IR_z(t_{n+1}) = V_z(t_{n+1})/I(t_{n+1})$ , (e) the slope of the variation in the internal resistance  $IRS_z$  of each module  $z$  is calculated between times  $t_n$  and  $t_{n+1}$  as follows:  $IRS_z = [IR_z(t_{n+1}) - IR_z(t)]/I(t_n)$ , (f) the maximum value  $IRS_{max}$  and the average value  $IRS_{avg}$  of the slopes of the variation in the internal resistance of all the modules are calculated, (g) a difference  $DIRS$  is calculated as follows:  $DIRS = IRS_{max} - IRS_{avg}$ , (h) the difference  $DIRS$  is compared to a criterion  $K$  determined experimentally, and (i) the first phase of discharging is stopped when  $DIRS$  is greater than or equal to  $K$ , following correction of the rate of change  $dI/dt$  of the discharging current  $I(t_n)$ .

6479968

**METHOD OF CHARGING A BATTERY UTILIZING  
DYNAMIC CABLE COMPENSATION**

Brian Thomas Pozsgay; Martin Hague Ramsden; Taneka Frazier; Ang Teik Heng; Australia assigned to Motorola Inc.

This invention includes a method for sensing the parasitic impedance in a battery charging system and compensating for these parasitic impedances. In one embodiment, the voltage of the system is measured with no charging current applied. Next, a charging current is applied and a second voltage is measured. The parasitic impedance is then extrapolated and multiplied by a predetermined rapid charging current. The product is added to a predetermined cell termination voltage. The charging means remains in a rapid charge current mode until a voltage equal to the sum of the impedance-current product and the predetermined voltage is reached, wherein the current is reduced to a maintenance charging level.

6480003

**METHOD FOR DETECTING DETERIORATION  
OF ELECTROCHEMICAL DEVICE, METHOD  
FOR MEASURING REMAINING CAPACITY,  
CHARGER COMPRISING THEM, AND  
DISCHARGE CONTROLLER**

Masaya Ugaji; Miho Kayama; Kenichi Takeyama; Japan assigned to Matsushita Electric Industrial Company Ltd.

The present invention is a deterioration detecting method for an electrochemical device comprising electrodes and an ion conductor, wherein an electrochemical characteristic of the electrochemical device is detected, and an obtained value is then compared with a standard electrochemical characteristic of the electrochemical device to estimate the degree of deterioration of the electrochemical device. Further, the capacity of the device is found based on the detected degree of deterioration, and using this and the output of the device, a remaining capacity of the device is estimated. Accordingly, the degree of deterioration and the remaining capacity of an electrochemical device such as a secondary battery can be accurately detected.

6483274

**DEVICE AND METHOD FOR DISPLAYING  
CHARGE CAPACITY INFORMATION  
OF SMART BATTERY**

Chang-Hum Lee; South Korea assigned to Samsung Electronics Company Ltd.

A device and a method for displaying an exact charge capacity of a smart battery includes a portable electric device including a control unit for power management. The portable electric device includes a battery for providing a relative state of charge (RSOC), a control unit for controlling the device to display battery residual capacity information by receiving the RSOC from the battery, and a display unit for displaying the battery residual capacity information. Here, the control unit detects an output voltage of the battery, compares the detected voltage with the RSOC, and controls the device to display the battery residual capacity information in response to data corresponding to the detected voltage, when the battery is in a period of a first low battery and the detected voltage is different from the RSOC, or controls the device to display the battery residual capacity information in response to the RSOC when the battery is in a period of a second low battery lower than the first low battery. Thus, the portable electric device can display the exact battery residual capacity information by correcting a period where an error is generated between the RSOC and the detected voltage.

*OTHER BATTERIES*

6468688

**HIGH ENERGY DENSITY VANADIUM  
ELECTROLYTE SOLUTIONS, METHODS OF  
PREPARATION THEREOF AND ALL-VANADIUM  
REDOX CELLS AND BATTERIES CONTAINING  
HIGH ENERGY VANADIUM ELECTROLYTE  
SOLUTIONS**

Michael Kazacos; Maria Skyllas Kazacos; Australia assigned to Pinnacle VRB Limited



Disclosed is a method for preparing a high energy density (HED) electrolyte solution for use in an all-vanadium redox cell: a high energy density electrolyte solution, in particular an all-vanadium high energy density electrolyte solution; a redox cell, in particular an all-vanadium redox cell comprising the high energy density electrolyte solution; a redox battery, in particular an all-vanadium redox battery comprising the HED electrolyte solution; a process for recharging a discharged or partially discharged redox battery, in particular an all-vanadium redox battery comprising the HED electrolyte solution; a process for the production of electricity from a charged redox battery, and in particular a charged all-vanadium redox battery comprising the HED electrolyte; a redox battery/fuel cell and a process for the production of electricity from a redox battery/fuel cell. A method for stabilising an electrolyte solution for use in a redox cell, in particular for stabilising an electrolyte solution for use in an all-vanadium redox cell; a stabilised electrolyte solution, in particular an all-vanadium stabilised electrolyte solution; a redox cell, in particular an all-vanadium redox cell comprising the stabilised electrolyte solution; a redox battery, in particular an all-vanadium redox battery comprising the stabilised electrolyte solution; a process for recharging a discharged or partially discharged redox battery, in particular an all-vanadium redox battery comprising the stabilised electrolyte solution; and a process for the production of electricity from a charged redox battery, and in particular a charged all-vanadium redox battery comprising the stabilised electrolyte solution are disclosed. Also disclosed are a redox battery/fuel cell and a process for the production of electricity from a redox battery/fuel cell.

**6468693**

**NONAQUEOUS ELECTROLYTE  
SECONDARY BATTERY**

Norio Takami; Takahisa Ohsaki; Japan assigned to Kabushiki Kaisha Toshiba

The present invention provides a nonaqueous electrolyte secondary battery, comprising a jacket having a wall thickness not larger than 0.25 mm, a positive electrode housed in the jacket and containing a positive electrode active material, a negative electrode housed in the jacket and containing a negative electrode active material, and a nonaqueous electrolyte housed in the jacket, wherein the positive electrode active material comprises at least one kind of oxide selected from the group consisting of an oxide containing an element M, Li and Ni and an oxide containing an element M, Li, Ni and Co, the element M being at least one element selected from the group consisting of Al, B, Sn and Nb, and the pH of the positive electrode active material falls within a range of between 10 and 12.

**6468694**

**HIGH ENERGY DENSITY BORIDE BATTERIES**  
Steven Amendola; USA assigned to Millennium Cell Inc.

Borides generally can produce a cell with a high energy density. High power densities are also achievable using borides that are reasonably good conductors of electricity. High density is important to achieve high energy density. Another important factor is lower molecular weight per available electron. The borides generally provide a favorable balance of these factors compared to a number of other materials, such as lithium or zinc. Individual borides have other important characteristics. Titanium diboride is safe. The inclusion of a halide, particularly fluoride, in the anodic storage medium significantly improves performance.

**6471850**

**LOW GRAVITY ELECTROCHEMICAL CELL**

Jason K. Shiepe; Trent M. Molter; USA assigned to Proton Energy Systems Inc.

An electrochemical cell system includes a hydrogen electrode; an oxygen electrode; a membrane disposed between the hydrogen electrode and the oxygen electrode; and a compartmentalized storage tank. The compartmentalized storage tank has a first fluid storage section and a second fluid storage section separated by a movable divider. The compartmentalized storage tank is in fluid communication with the electrochemical cell. Further, an electrochemical cell includes a hydrogen electrode; an oxygen electrode; an electrolyte membrane disposed between and in intimate contact with the hydrogen electrode and said oxygen electrode; an oxygen flow field disposed adjacent to and in intimate contact with the oxygen electrode; a hydrogen flow field disposed adjacent to and in intimate contact with the hydrogen electrode; a water flow field disposed in fluid communication with the oxygen flow field; and a media divider disposed between the oxygen flow field and the water flow field.

**6472093**

**METAL-AIR FUEL CELL BATTERY SYSTEMS  
HAVING A METAL-FUEL CARD STORAGE  
CARTRIDGE, INSERTABLE WITHIN A FUEL  
CARTRIDGE INSERTION PORT, CONTAINING  
A SUPPLY OF SUBSTANTIALLY PLANAR  
DISCRETE METAL-FUEL CARDS, AND FUEL  
CARD TRANSPORT MECHANISMS THEREIN**

Sadeg M. Faris; Tsepin Tsai; USA assigned to Reveo Inc.

Disclosed are various types of metal-air FCB-based systems comprising a housing having an insertion port; a discharging subsystem disposed within the housing for generating electrical power from at least one metal-fuel card in a discharging mode of operation; and a tray-shaped cartridge, insertable within said insertion port, containing a supply of substantially planar discrete metal-fuel cards. When the tray-shaped cartridge is inserted within the insertion port, one or more of the metal-fuel cards are loadable into the discharging subsystem for generating and discharging electrical power during the discharging mode of operation. The

system may include a recharging subsystem disposed within the housing for recharging at least one metal-fuel card in a recharging mode of operation. These inventive features allow automatic management of the supply (and recharge) of metal-fuel in a metal-air fuel cell battery system so as to obtain improvements in both operating efficiency and system performance.

**6472100****NONAQUEOUS-ELECTROLYTE BATTERY**

Junichi Maruta; Japan assigned to Japan Storage Battery Company Ltd.

In a nonaqueous-electrolyte battery, a positive active material contains oxyhydroxide of nickel and aluminum. The positive active material may further contain oxyhydroxide of cobalt.

**6479190****SEPARATOR FOR BATTERY HAVING ZINC ELECTRODE**

C. Glen Wensley; USA assigned to Celgard Inc.

The instant invention is directed to a separator for a battery having a zinc electrode. The first embodiment of the separator comprises a microporous membrane and a coating on at least one surface of the membrane. The coating comprises a mixture of cellulose acetate and a surfactant. The surfactant has an active ingredient selected from the group of organic ethers. The second embodiment of the separator consists essentially of a microporous membrane having an effective average pore size of less than  $0.045\ \mu\text{m}$ , having a thickness less than 1.5 mils, having an electrical resistance of less or equal to  $30\ \text{m}\Omega\ \text{in.}^2$ , and being adapted for wetting by an aqueous electrolyte.