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***Journal of Power Sources***

*LEAD-ACID***6406813****LEAD-ACID SEPARATORS AND CELLS AND BATTERIES USING SUCH SEPARATORS**

Purushothama Rao; USA assigned to GNB Technologies Inc.

A sealed lead-acid cell utilizes a separator made with modified plastic microfibers having a contact angle of no more than  $1.5^\circ$  to the sulfuric acid electrolyte used and having a diameter of 1.1–5.0  $\mu\text{m}$ , the separator having a porosity of 87–94%, a surface area of 1.0–2.2  $\text{m}^2/\text{gm}$ , and a maximum pore diameter of 8–20  $\mu\text{m}$  and a mean pore diameter of 1.2–5.0  $\mu\text{m}$ .

**6342110****LEAD AND LEAD ALLOYS WITH ENHANCED CREEP AND/OR INTERGRANULAR CORROSION RESISTANCE, ESPECIALLY FOR LEAD-ACID BATTERIES AND ELECTRODES THEREFOR**

Gino Palumbo; Canada assigned to Integran Technologies Inc.

Recrystallized lead and lead alloy positive electrodes for lead acid batteries having an increased percentage of special grain boundaries in the microstructure, preferably to at least 50%, which have been provided by a process comprising steps of working or straining the lead or lead alloy, and subsequently, annealing the lead or lead alloy. Either a single cycle of working and annealing can be provided, or a plurality of such cycles can be provided. The amount of cold work or strain, the recrystallization time and temperature, and the number of repetitions of such steps are selected to ensure that a substantial increase in the population of special grain boundaries is provided in the microstructure, to improve resistance to creep, intergranular corrosion and intergranular cracking of the electrodes during battery service, and result in extended battery life and the opportunity to reduce the size and weight of the battery.

**6410183****BATTERY SEPARATOR WITH IMPROVED SHOULDERS**

Daniel E. Weerts; Gordon B. Dobbie; USA

A battery separator for use in enveloping the plates of a flooded cell type lead acid battery. The separator has improved puncture resistance in the shoulder areas provided by a plurality of improved mini-ribs located therein. The mini-ribs have substantially flat upper surfaces, and the space between adjacent mini-ribs is less than about 0.0225 in. The separator may also have a plurality of micro-ribs located on the backside.

*BATTERY MATERIALS***6406817****CROSSLINKED POLYMER, ELECTROLYTE USING THE POLYMER, AND NON-AQUEOUS SECONDARY BATTERY USING THE ELECTROLYTE**

Koji Wariishi; Hideki Tomiyama; Yukio Maekawa; Japan assigned to Ube Industries Ltd.

A crosslinked polymer with high ionic conductivity, an electrolyte using the crosslinked polymer and a process for producing the electrolyte, and a non-aqueous secondary battery using the electrolyte. Crosslinked polymers obtained by a crosslinking reaction between a compound having at least two substituents, in total, of at least one kind selected from the group consisting of  $\alpha,\beta$ -unsaturated sulfonyl,  $\alpha,\beta$ -unsaturated nitril and  $\alpha,\beta$ -unsaturated carbonyl groups in its molecule and a compound having at least two nucleophilic groups in its molecule.

**6395419****SOLID POLYMER ELECTROLYTE, METHOD OF MAKING, AND ELECTROCHEMICAL DEVICE USING THE SAME**

Tsuneo Kuwahara; Satoshi Maruyama; Kazuhide Ohe; Japan assigned to TDK Corporation

A solid polymer electrolyte is prepared by forming a polymer solution containing a filler into a film, evaporating off the solvent from the film, and impregnating the film with an electrolytic solution. The impregnated polymer electrolyte has a swelling factor of at least 2.2. The method is efficient enough to produce the polymer electrolyte at a low cost. The polymer electrolyte is useful in electrochemical devices such as lithium secondary batteries and electric double layer capacitors.

**6403255****POLYVINYL MERCAPTAN REDOX MATERIAL FOR CATHODES IN NON-AQUEOUS BATTERIES**

Yosef Gofer; Anatoly M. Belostotskii; Doron Aurbach; Israel assigned to Bar Ilan University

A cathode material featuring PVM for use in rechargeable electrochemical cells. It has been discovered that the polymer backbone of PVM, which consists solely of carbon atoms, is not subject to scission during repeated charge–discharge cycles, such that the cathode material remains substantially insoluble in standard liquid electrolytes. As a result, cells containing PVM as the cathode material and liquid electrolyte are genuinely electrochemically reversible. The use of PVM overcomes the problems associated with organosulfides of the background art, with which dissolution of anions in the liquid electrolyte during discharging results in migration from the

cathode and contamination of the anode/electrolyte surface and ultimately leads to degradation of the electrolyte and/or deterioration of the anode-electrolyte interface.

**6403259**

**NON-AQUEOUS ELECTROLYTE SECONDARY BATTERY COMPRISING CARBON PARTICLES WITH A PLURAL-LAYER STRUCTURE**

Masaki Kitagawa; Hizuru Koshina; Toyoji Sugimoto; Shoji Yamaguchi; Manabu Hayashi; Japan assigned to Matsushita Electric Industrial Company Ltd., Mitsubishi Chemical Corporation

Enhancement of the storage property at a high temperature and discharge characteristics at a low temperature of a non-aqueous electrolyte secondary cell is intended. A negative electrode material which is prepared by covering the surface of a nucleus made of a graphite powder with a carbonaceous matter, the graphite powder having a specified plane interval, spectrum value, mean particle size, specific surface area, tapping density, and (1 1 0)/(0 0 4) X-ray peak intensity ratio, is used in the non-aqueous electrolyte secondary cell.

**6403265**

**BATTERY SEPARATOR, PROCESS FOR PRODUCING THE SAME, AND ALKALINE BATTERY**

Toshio Tanaka; Hiroki Yamaguchi; Naohiko Takimoto; Masahiro Yamashita; Shiro Hamamoto; Japan assigned to Toyo Boseki Kabushiki Kaisha

A battery including a separator having a satisfactory ammonia trapping property is speculated to exhibit a less self-discharge and a higher capacity-holding rate. The ammonia trapping property is speculated to be increased with an increasing degree of sulfonation of a constitutive polyolefin fiber. However, a highly sulfonated conventional polyolefin has a deteriorated fiber strength and highly sulfonated portions thereof are peeled or eliminated, and the resulting fiber cannot have a significantly high degree of sulfonation. The invention is therefore, intended to provide a separator having an improved ammonia trapping property. The invented separator includes a polyolefin resin fiber having large amounts of introduced sulfonic groups. Specifically, the separator is one containing a fiber obtained by sulfonating a polyolefin resin fiber having an intrinsic viscosity number of 0.2–1.0 dl/g, one including a fiber obtained by sulfonating a polyolefin resin fiber and having a BET specific surface area of 0.5 m<sup>2</sup>/g or more, or one including a fiber obtained by oxidizing a polyolefin fiber and sulfonating the oxidized fiber.

**6403266**

**POLYMER ELECTROLYTE COMPOSITION, METHOD FOR PREPARING THE SAME AND**

**LITHIUM SECONDARY BATTERY EMPLOYING THE SAME**

Hee Tak Kim; Kyoung Bae Kim; Sun Wook Kim; South Korea assigned to Ness Energy Company Ltd.

Disclosed are a polymer electrolyte composition, a method for preparing the same and a lithium secondary battery employing the same. The polymer electrolyte composition comprises a polymer mixture and a solvent in which a lithium salt is disclosed. The polymer mixture includes polyvinylidene fluoride-based polymer and at least one polymer selected from the group consisting of polyacrylonitrile and polymethyl methacrylate. Polyvinylidene fluoride-based polymer which has a good mechanical strength, polymethyl methacrylate polymer which has a good affinity and polyacrylonitrile polymer which has a good adhesiveness to electrodes are utilized. As a result, the mechanical strength and the adhesiveness to the electrodes of the polymer electrolyte can be improved to obtain a lithium secondary battery which has a stable charge/discharge characteristic and a high capacity.

**6406816**

**POLYMERIC GEL ELECTROLYTE**

Rifat A.M. Hikmet; The Netherlands assigned to U.S. Philips Corporation

A multi-phase polymeric gel electrolyte for use in a rechargeable lithium battery has an ion-conductivity of more than 1 mS/cm and comprises a continuous ion-conductive liquid-phase interpenetrating a solid-phase. The solid-phase which is obtained by polymerizing alkane monomers has a microscopic network structure which is selected, such that when the electrolyte is employed in a rechargeable lithium metal battery, the battery is capable of being fully charged and discharged at a 0.2 C rate more than 20 times without short-circuiting due to dendritic growth. Suitable microscopic network structures are obtained using polydecandiol-diacrylates. A method of preparing said electrolytes involves polymerizing a one-phase polymerizable composition which undergoes 1a phase separation during polymerization.

**6410182**

**METHOD OF MAKING SEPARATORS FOR ELECTROCHEMICAL CELLS COMPRISING A MICRO-POROUS PSEUDO-BOEHMITE LAYER**

Qicong Ying; Steven A. Carlson; Terje A. Skotheim; USA assigned to Moltech Corporation

This invention pertains to separators for electrochemical cells which comprise (i) a microporous pseudo-boehmite layer, and (ii) a protective coating layer comprising a polymer; electrolyte elements comprising such separators; electrical current producing cells comprising such separators, and methods of making such separators, electrolyte elements and cells.

**FUEL CELL****6406807****DISTRIBUTION OF HYDRATION FLUID IN  
A FUEL CELL**

Milton H. Nelson; Charles M. Carlstrom, Jr.; Mathew J. Cusack; John R. Miller; USA assigned to Plug Power Inc.

A hydration system for a fuel cell includes a fluid flow plate having an inlet fluid opening for receiving a hydration fluid, a plurality of reactant flow channels defined in the fluid flow plate, at least one land interposed between the flow channels, and at least one hole defined in and extending through the land. The hole may be fluidly connected to the inlet fluid opening, thereby allowing a portion of the fluid to aid in hydration of a membrane of the fuel cell. A hydration channel also formed in the land may extend from an outlet of the hole to further aid membrane hydration.

**6406808****METHOD AND APPARATUS FOR THERMAL  
MANAGEMENT OF FUEL CELL SYSTEMS**

Steven D. Pratt; Ronald J. Kelley; Sivakumar Muthuswamy; Robert W. Pennisi; USA assigned to Motorola Inc.

A method and apparatus for managing thermal performance of a fuel cell system having a fuel cell assembly and a fuel storage container is disclosed. The fuel cell system consists of one or more fuel cells, each having a major surface, and disposed next to each other in a side-by-side adjacent arrangement and a fuel storage container having an exterior wall. The fuel cells are positioned such that distance between the major surfaces and the fuel storage container wall along a direction normal to the major surfaces is substantially the same. In addition, one or more of the fuel cells are in thermal contact with the fuel storage container such that cell waste heat is transferred to the fuel storage container.

**6406809****FUEL CELL COMPRISING A SEPARATOR  
PROVIDED WITH COOLANT PASSAGES**

Yosuke Fujii; Yoshinori Wariishi; Narutoshi Sugita; Masaharu Suzuki; Japan assigned to Honda Giken Kogyo Kabushiki Kaisha

Each of cooling medium flow passages provided for a first separator includes single main flow passage grooves communicating with a cooling medium inlet and a cooling medium outlet, respectively, and branched flow passage grooves formed and branched between the main flow passage grooves. Accordingly, it is possible to greatly decrease the flow passage length. Therefore, it is possible to effectively avoid the occurrence of flow passage pressure loss in the

superficial direction of the first separator, and it is possible to improve the system efficiency of the power generation.

**6406810****FUEL CELL SYSTEM WITH CATHODE-SIDE  
WATER SEPARATING DEVICES**

Gerhard Konrad; Arnold Lamm; Steffen Wieland; Germany assigned to DaimlerChrysler AG

A fuel cell system includes at least one fuel cell which contains an anode space with an inlet-side anode feed and an outlet-side anode discharge; a cathode space with an inlet-side cathode feed and an outlet-side cathode discharge; and water separating devices arranged in the cathode discharge. According to the invention, the water separating devices contain a water separating membrane unit with a mixture space situated in the cathode discharge and a water collecting space separated therefrom by a water separating membrane.

**6408966****FUEL CELL VEHICLE**

Uwe Benz; Gerald Hornburg; Werner Tillmetz; Germany assigned to Xcellsis GmbH

A fuel cell vehicle comprises an electric drive system and a fuel cell system for providing electric energy for the drive system. According to the invention, the electric drive system is set up for regenerating braking energy, and devices are provided for the direct utilization of the regenerated braking energy in at least one energy-consuming component of the fuel cell system. This direct braking energy utilization in the fuel cell system increases the degree of energy utilization without the requirement of a separate intermediate energy storage device for the intermediate storing of regenerated braking energy.

**6409974****WATER GAS SHIFT PROCESS AND APPARATUS  
FOR PURIFYING HYDROGEN FOR USE WITH  
FUEL CELLS**

Gavin P. Towler; Kurt Vanden Bussche; USA assigned to UOP LLC

A process and apparatus are disclosed for the operation of a compact water gas shift reactor for use in conjunction with fuel cell to generate electric power from a feed stream comprising a hydrocarbon or an alcohol. The fuel cell comprises a proton exchange membrane which produces electric power from a hydrogen product stream which comprises essentially no carbon monoxide. The hydrogen product stream may produced from the feed stream in a steam reforming of autothermal reforming zone. The compact water gas shift reactor comprises a vertically aligned vessel having a top end, a bottom end opposite, which

defines an interior space. The interior space contains a first water spray zone for contacting a reforming effluent stream comprising hydrogen with a first water stream. A first dispersion zone is disposed below the first water spray zone and above a high temperature shift zone. The high temperature shift zone contains a high temperature shift catalyst to produce a high temperature shift effluent stream. A second water spray zone is disposed below the high temperature shift zone and above a second dispersion zone. A low temperature shift zone is disposed below the second dispersion zone. The low temperature shift zone contains a low temperature shift catalyst to produce a water saturated hydrogen product stream which comprises <50 ppm mole carbon monoxide. The water dispersion zones simplify the overall shift reaction zone and provide protection for the shift catalysts from temperature shock.

**6410175**

**FUEL CELL SYSTEM WITH IMPROVED STARTING CAPABILITY**

Werner Tillmetz; David P. Wilkinson; Kevin M. Colbow; Jean St.-Pierre; Germany assigned to Ballard Power Systems Inc.

A method of commencing operation of a fuel cell system which includes a fuel reformer is provided. During a start-up period, the same fuel which is used in the feedstock to the reformer is directed to at least a portion of the fuel cells in the system. These fuel cells provide output power by direct oxidation of the fuel, at least until the reformer is operational, producing a hydrogen-containing gas stream suitable for the fuel cells. Thus, useful output power can be obtained from the system without the delay typically associated with start-up of the reformer.

**6410176**

**VOLTAGE MONITORING SYSTEM FOR A FUEL CELL STACK**

Suat Genc; Larry A. Pitts; Kevin L. Mease; Charles M. Carlstrom; Russel H. Marvin; USA assigned to Plug Power Inc.

An assembly includes a fuel cell stack, a circuit board, an elastomeric connector and a frame. The elastomeric connector contacts the stack to provide cell voltages of the stack to the circuit board. The frame holds the circuit board, positions the elastomeric connector between the fuel cell stack and the circuit board and provides the appropriate compression of the connector.

**6410177**

**FUEL CELL HAVING GAS MANIFOLD**

Kotaro Iyasu; Yoshitsugu Gocho; Yoshihiro Moriyama; Akio Kano; Kazuhisa Tanaka; Japan assigned to Kabushiki Kaisha Toshiba

Each of gas manifolds which are disposed on the side surfaces of a cell stack is constituted by integrating a plate-like heat insulating member disposed on the outer surface of the cell stack and a heat and phosphoric acid resisting sheet member joined to cover the inner and side surfaces of the heat insulating member.

**6410180**

**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.

*LITHIUM BATTERIES*

**6391495**

**NEGATIVE ACTIVE MATERIAL FOR LITHIUM SECONDARY BATTERY, METHOD OF PREPARING THE SAME AND LITHIUM SECONDARY BATTERY COMPRISING THE SAME**

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

A negative active material for a lithium secondary battery includes a crystalline graphite core and a carbon shell. The carbon shell includes at least one material selected from a transition metal, an alkali metal, an alkaline earth metal, an element of Group 3B of the Periodic table, an element of Group 4B, an element of Group 5B or a mixture thereof. The carbon shell is a turbostratic carbon layer, or an amorphous or crystalline carbon layer having different physical properties from the core. The negative active material can be used in a lithium secondary battery such that the battery has a large discharge capacity and a high charge/discharge efficiency.

6395427

**NEGATIVE ACTIVE MATERIAL FOR RECHARGEABLE LITHIUM BATTERY AND METHOD OF PREPARING SAME**

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

A negative active material for a rechargeable lithium battery which exhibits good discharge capacity and charge and discharge efficiency, and enables the use of all types of electrolytes. The active material includes a crystalline carbon core and a semi-crystalline carbon shell. The semi-crystalline carbon shell includes at least one element or a compound of at least two different types of elements, and has a turbostratic or half onion-sheath. The compound includes only element. The element serves graphitization catalyst and causes a change in a structure of surrounding carbon. In particular, the negative active material includes metal boride.

6395430

**HYBRID POLYMER ELECTROLYTE FOR LITHIUM BATTERY AND METHOD OF PREPARING SAME**

Jae-phil Cho; Geun-bae Kim; Yong-chul Park; South Korea assigned to Samsung Display Devices Company Ltd.

A hybrid polymer electrolyte includes a copolymer matrix of poly(vinyl chloride) and poly(vinylidene chloride) having a plurality of pores, and a solution of an alkali metal salt in an organic solvent entrained in the pores of the copolymer matrix. The pores of the copolymer matrix occupy 10–50 vol.% of the hybrid polymer electrolyte.

6403258

**LITHIUM SECONDARY BATTERY COMPRISING TUNGSTEN COMPOSITE OXIDE**

Seiji Yoshimura; Masahisa Fujimoto; Shin Fujitani; Japan assigned to Sanyo Electric Company Ltd.

In a lithium secondary battery provided with a positive electrode, a negative electrode, and a non-aqueous electrolyte, a tungsten oxide  $W_{20}O_{58}$  or  $W_{18}O_{49}$ , or the tungsten oxide to which lithium is added, or a tungsten composite oxide comprising a tungsten oxide containing at least one type of metal element selected from the group consisting of Mn, Cu, V, Cr, Fe, Co, and Ni and having a  $W_{20}O_{58}$ -type or  $W_{18}O_{49}$ -type crystal structure or the tungsten composite oxide to which lithium is added is used as a positive electrode active material for said positive electrode or a negative electrode active material for said negative electrode.

6403263

**CATHODE CURRENT COLLECTOR FOR ELECTROCHEMICAL CELLS**

Joseph M. Roach; USA assigned to Moltech Corporation

Provided are cathode current collectors for use in electrochemical cells, wherein the current collector comprises a conductive primer layer applied upon a conductive support, and the primer layer comprises from about 25 to 70% by weight of a crosslinked polymeric material formed from a reaction of a polyvinyl acetal and a crosslinking agent, and about 30–75% by weight of a conductive filler. The present invention also pertains to methods of forming such cathode current collectors for use in electrochemical cells comprising (i) an anode comprising lithium, and (ii) a cathode comprising an electroactive sulfur-containing material.

6406815

**COMPACT LITHIUM ION BATTERY AND METHOD OF MANUFACTURING**

Murray G. Sandberg; Morgan Rey Benson; USA assigned to Delphi Technologies Inc.

Described is a lithium ion battery comprising: A housing having a front side and a backside 15 and an anode cell terminal and a cathode cell terminal separated therefrom; positioned within the housing a plurality of bipolar lithium ion cells having an lithium ion permeable plastic separator there between; the cell electrodes being comprised of a thin film plastic substrate and being electrically connected appropriately to the anode and the cathode cell terminals; wherein the cells are longitudinally placed in the housing parallel to the sides of the housing; and wherein the housing is enclosed by the cathode cell terminal at one end and the anode cell terminal at the opposite end of the cell sleeve; and the enclosed housing is capable of receiving an electrolyte placed between the cells and the electrolyte is capable of carrying ions between the anode and the cathode. Also described is a method of manufacturing the lithium ion batteries.

6409984

**SPINEL-TYPE LITHIUM MANGANESE COMPLEX OXIDE FOR A CATHODE ACTIVE MATERIAL OF A LITHIUM SECONDARY BATTERY**

Koji Hattori; Yasuhisa Yamashita; Japan assigned to Murata Manufacturing Company Ltd.

The invention provides a spinel-type lithium manganese complex oxide for use as a cathode active material of a lithium secondary battery, which is characterized in that said spinel-type lithium manganese complex oxide has an average particle diameter between about 1 and 5  $\mu\text{m}$  and a specific surface area between about 2 and 10  $\text{m}^2/\text{g}$ . The invention also provides a process for producing the spinel-type lithium manganese

complex oxide comprises the steps of (1) atomizing and pyrolyzing an aqueous or alcohol solution of compounds containing metallic salts constituting a spinel-type lithium manganese complex oxide to obtain said complex oxide, and (2) annealing said spinel-type lithium manganese complex oxide to increase the average particle diameter thereof to between about 1 and 5  $\mu\text{m}$  and adjust the specific surface area thereof to between about 2 and 10  $\text{m}^2/\text{g}$ . The spinel-type lithium manganese complex oxide exhibits a large charge-discharge capacity and excellent charge-discharge cycle characteristics, and it can be used in a 4 V region secondary battery.

**6410181**

**HIGH TEMPERATURE LITHIUM OXYHALIDE  
ELECTROCHEMICAL CELL**

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

An alkali metal electrochemical cell, and particularly a lithium oxyhalide cell, is described. The oxyhalide cell also exhibits superior restart characteristics by the provision of a MANNIGLASS 1200 separator.

**6410188**

**NON-AQUEOUS ELECTROLYTE SECONDARY  
CELL**

Takayuki Shirane; Yoshiaki Nitta; Shuji Tsutsumi; Masaki Hasegawa; Junichi Yamaura; assigned to Matsushita Electric Industrial Company Ltd.

A non-aqueous electrolyte secondary battery using lithium containing composite oxide, which intercalates and de-intercalates lithium, for a positive electrode; and lithium containing composite nitride and a compound having a large irreversible capacity for a negative electrode. Metal oxide is used as a material for the negative electrode, and lithium containing composite nitride represented by the general formula of  $\text{Li}_{3-x}\text{M}_x\text{N}$  (M is a transition metal,  $0.2 < x < 0.8$ ) is also contained in the negative electrode. Lithium containing composite nitride containing cobalt as its transition metal M is further preferable because it has high capacity and good reversibility. For the positive electrode of the secondary battery, lithium containing composite oxide such as lithium cobaltate, lithium nickelate, their composite compound, and lithium manganate ( $\text{LiMn}_2\text{O}_4$ ) may be used. High capacity and high quality non-aqueous electrolyte secondary battery with good cycle reversibility may be obtained by adding lithium containing composite nitride to the negative electrode.

*COMPONENTS AND/OR CHARGES*

**6404163**

**METHOD AND SYSTEM FOR REGULATING A  
CHARGE VOLTAGE DELIVERED TO A BATTERY**

Nick S. Kapsokavathis; Michael Frank Matouka; David William Walters; USA assigned to General Motors Corporation

A method of regulating a charge voltage delivered to a battery in an automobile, wherein the automobile has an engine and an ignition system capable of being activated with an ignition switch, is provided. The method includes the steps of periodically estimating the electrolyte temperature of the battery when the ignition switch is on, periodically sensing the voltage of the battery, using the estimated electrolyte temperature and the sensed voltage to estimate the electric current of the battery, using the estimated electric current to estimate the amp-hours into the battery, using the estimated ampere-hours to estimate the state of charge of the battery when the engine is running, using the running state of charge and the estimated electrolyte temperature to determine an optimum charge voltage for the battery, using the sensed voltage to adjust the optimum charge voltage, communicating the optimum charge voltage to a generator, and using the generator to deliver a charge voltage to the battery wherein the charge voltage is regulated by the optimum charge voltage. Also, a system for implementing the method is provided. The system includes a generator, an engine control module, a sensor for sensing the temperature of air entering into the engine, an actuator capable of adjusting the idle speed of the engine, a data link, a body control module, a plurality of body controllers, and a plurality of electrical loads.

**6404164**

**METHOD OF BATTERY CHEMISTRY  
IDENTIFICATION THROUGH ANALYSIS OF  
VOLTAGE BEHAVIOR**

Heather N Bean; Scott A Woods; Christopher A. Whitman; USA assigned to Hewlett-Packard Company

A method of identifying battery chemistry of a battery in an electronic device monitors voltage behavior of the battery in response to a stimulus. The method can be performed in the electronic device while the device is in normal operation without affecting battery life or the user's enjoyment. Further, the method can be performed many times within the device also without compromising battery life or user enjoyment. A system implements the method in the electronic device. The present invention provides for more accurate battery fuel gauging, such that a battery's end of life is more readily determinable, and allows for various battery chemistries to be drained to their optimal cutoff voltage, and allows for the safe in-device charging of rechargeable batteries that are the same size and shape as non-rechargeable batteries.

**6404169**

**AUTO-CONTROLLER FOR BATTERY CHARGER  
USING THERMO-CONTROL AND CURRENT BAL-  
ANCE TECHNOLOGY**

Randall Wang; USA

An auto-controller is adapted for incorporating with a battery charger to charge a battery by using a thermo-control and current balance technology for extending a service life span of the battery while being cost effective. The auto-controller includes a resistor having a predetermined resistance for electrically connecting to the battery charger wherein the resistor generates heat when a predetermined current flows through that defines a reference temperature for the battery charger, and a thermo sensor operatively positioned adjacent to the resistor for detecting the reference temperature and selectively switching the battery charger on and off, whereby when the reference temperature is above a control temperature preset in the thermo sensor, the battery charger is switched off to not function and when the reference temperature is below the control temperature, the battery charger is maintained in a switch-on condition to continuously charge a battery.

**6411097**

**ELECTRONIC CIRCUIT FOR MEASURING  
SERIES CONNECTED ELECTROCHEMICAL  
CELL VOLTAGES**

Cyrus N Ashtiani; Thomas A Stuart; USA assigned to DaimlerChrysler Corporation

An electronic circuit for measuring voltage signals in an energy storage device is disclosed. The circuit includes a plurality of battery segments forming the energy storage device. An amplifier circuit is connected across one of the battery segments for converting a differential voltage to a reference current. A sense resistor is associated with the amplifier circuit to convert the reference current to a voltage signal which is proportional to the voltage across the battery segment. A voltage measurement node associated with the sensing resistor may be used for measuring the voltage signal. In one embodiment of the invention, a multiplexing and sampling circuit provides digitized voltage samples to a processor. The voltage level of each cell within the battery pack can then be monitored by the processor.

**6411911**

**BATTERY DIAGNOSTIC METHOD UTILIZING  
A UNIVERSAL NORMALIZED DISCHARGE  
CURVE FOR PREDICTING BATTERY  
RESERVE TIME**

Marc Daniel Hirsch; Gregory W. Mathiesen; Patrick Kwok-Yeung Ng; USA assigned to Tyco Electronics Logistics AG

A method for monitoring and diagnosing the status of a battery in an electrical system, more particularly, a method for determining a battery's reserve time based on comparison of measurements made during a battery discharge to a universal normalized discharge curve. Specifically, a battery

discharge is initiated and the battery's voltage and discharge time is continuously measured. The measured battery voltage is normalized by dividing it by either the peak voltage or foothill voltage, as monitored during the discharge. By comparing this normalized voltage measurement to a universal normalized discharge curve, the percent discharge level of the battery is determined. Using the percent discharge level and the discharge time, the reserve time and total capacity of the battery can be determined.

*OTHER BATTERIES*

**6403253**

**AQUEOUS RECHARGEABLE BATTERY**

David S. Wainwright; Wu Li; Jeffrey R. Dahn; Canada assigned to Moli Energy (1990) Limited

Rechargeable batteries based on the 'rocking chair' principle and alkali or alkaline earth insertion compounds are disclosed that employ aqueous electrolytes. Batteries of the invention can have energy densities comparable to conventional aqueous batteries. Embodiments of the invention include aqueous lithium ion batteries.

**6403256**

**ALKALI METAL ELECTROCHEMICAL CELL  
ACTIVATED WITH A NON-AQUEOUS ELECTRO-  
LYTE HAVING A SULFITE ADDITIVE**

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

An alkali metal, solid cathode, non-aqueous electrochemical cell capable of delivering high current pulses, rapidly recovering its open circuit voltage and having high current capacity, is described. The stated benefits are realized by the addition of at least one organic sulfite additive to an electrolyte comprising an alkali metal salt dissolved in a mixture of a low viscosity solvent and a high permittivity solvent. A preferred solvent mixture includes propylene carbonate, dimethoxyethane and a sulfite additive having at least one unsaturated hydrocarbon containing a C (sp<sup>2</sup> or sp<sup>3</sup>)-C (sp<sup>3</sup>) bond unit having the C (sp<sup>3</sup>) carbon directly connected to the -OSO<sub>2</sub>- functional group.

**6403244**

**METAL-AIR FUEL CELL BATTERY SYSTEM  
EMPLOYING HYDROSTATIC FORCES TO  
ENABLE SIMULTANEOUS TRANSPORT OF  
METAL-FUEL TAPE, MOVABLE CATHODE  
STRUCTURE, AND IONICALLY-CONDUCTIVE  
MEDIUM THERE THROUGH DURING  
SYSTEM OPERATION**

Sadeg M. Faris; Tsepin Tsai; Thomas J. Legbandt; Wayne Yao; Muguo Chen; USA assigned to Reveo Inc.



In an air–metal fuel cell battery (FCB) system, wherein a movable cathode structure is mounted within a housing through which metal–fuel tape is transported along a predetermined path while an ionically-conductive medium is disposed between the metal–fuel tape and the movable cathode structure. In illustrative embodiments, the movable cathode structure is realized as a rotatable cathode cylinder, and a transportable cathode belt. The ionically-conductive medium is realized as a solid-state ionically-conductive film applied to the cathode structures and/or metal–fuel tape, as well as ionically-conductive belt structures. During system operation, the metal–fuel tape and/or the ionically-conductive medium are wetted in order create sufficient surface tension, and thus sufficient hydrostatic forces, between the metal–fuel tape and ionically-conductive medium and between the ionically-conductive medium and the movable cathode structure, to enable the movable cathode structure, ionically-conductive medium and metal–fuel tape to move at substantially the same velocity at points of contact there between while only one or these three moving system components are being actively driven by a transport mechanism. By virtue of the present invention, it is possible to transport the moving components of the FCB system using a various types of low power devices including, for example, miniature electrical and spring-driven motors, while substantially reducing the likelihood of damage thereto during system operation.

**6410174**

**METAL–AIR FUEL CELL BATTERY SYSTEM  
HAVING MEANS FOR BI-DIRECTIONALLY  
TRANSPORTING METAL–FUEL TAPE AND  
MANAGING METAL–FUEL AVAILABLE  
THEREALONG**

Sadeg M. Faris; USA assigned to Reveo Inc.

Disclosed is a metal–air fuel cell battery system, wherein metal–fuel tape can be transported through its discharging head assembly as well as its recharging head assembly in a bi-directional manner while the availability of metal–fuel therealong is automatically managed in order to improve the performance of the system.

**6410187**

**PRIMARY ALKALINE BATTERY**

Weifang Luo; Bhupendra K. Patel; Alexander B. Shelekhin; John D. Sillesky; Viet H. Vu; Douglas Woodnorth; USA assigned to The Gillette Company

A primary alkaline battery includes a housing, a cathode within the housing, an anode within the housing, and a separator electrically separating the anode and the cathode. The battery has a substantial  $(S/V)^2$  value.