

최신 미국특허 등록 목록

■ Multiple membrane embolic protection filter

- 등록 번호 : 7481823
- 발명자 : Broome, Thomas E. (Shakopee, MN, US), Voeller, Virgil (St. Louis Park, MN, US), Beulke, Mel (Bloomington, MN, US), Vrba, Anthony C. (Maple Grove, MN, US)
- 출원인 : Boston Scientific Scimed, Inc. (Maple Grove, MN, US)
- 초록 : An embolic protection filter having a plurality of filter membranes for collecting embolic debris within a body lumen is disclosed. An embolic protection filter in accordance with an exemplary embodiment of the present invention includes a first filter membrane coupled to an elongated member, a second filter membrane coupled to the elongated member distal the first filter membrane, and an actuator mechanism for actuating the embolic protection filter within a vessel.

■ Device for treatment of barrier membranes

- 등록 번호 : 7480530
- 발명자 : Sun, Ying (Belle Mead, NJ, US), Liu, Jue-Chen (Belle Mead, NJ, US), Wu, Jeffrey M. (Warrington, PA, US)
- 출원인 : Johnson & Johnson Consumer Companies, Inc. (Skillman, NJ, US)
- 초록 : The present invention features a device having a barrier membrane contacting surface, the device containing: a power source; a first conductive electrode; a second conductive electrode; and a carrier; wherein the power source is in electric communication with the first conductive electrode and the second conductive electrode, wherein the first conductive electrode and the second conductive electrode are in ion-

ic communication with the carrier, and wherein the carrier is in communication with the barrier membrane contacting surface.

■ Composite polyamide reverse osmosis membrane and method of producing the same

- 등록 번호 : 7479300
- 발명자 : Koo, Ja-Young (Billerica, MA, US), Hong, Sung Pyo (Kyungbuk, KR), Lee, Jong Hwa (Seoul, KR), Kim, Jun Suk (Seoul, KR)
- 출원인 : Woongjin Chemical Co., Ltd. (Gyeongsangbuk-Do, KR)
- 초록 : A composite polyamide reverse osmosis membrane and method of producing same. In a preferred embodiment, the membrane is made by coating a porous polysulfone support with an aqueous solution containing 2 wt% m-phenylenediamine (MPD), and 0.1 wt% di(ethylene glycol) hexyl methyl ether. Next, the excess solution is removed, and the coated support is dipped in 0.1 wt% organic solvent solution of trimesoyl chloride (TMC) in a mixture of alkanes having from 8 to 12 carbon atoms. After draining the TMC solution off, the resulting composite membrane is air dried and then rinsed in a basic aqueous solution. The resultant membrane exhibits a flux of 21.3 gfd and a salt rejection of 98.9% when used at 225 psi for an aqueous solution containing 2000 ppm of NaCl.

■ Methods of administering an active agent to a human barrier membrane with galvanic generated electricity

- 등록 번호 : 7477940
- 발명자 : Sun, Ying (Belle Mead, NJ, US), Wu,

Jeffrey (Warrington, PA, US), Liu, Jue-Chen (Belle Mead, NJ, US)

- 출원인 : J&J Consumer Companies, Inc. (Skillman, NJ, US)
- 초록 : The present invention features a method of administering an active agent to a human barrier membrane by applying to the membrane a device including a housing having the barrier membrane contacting surface, a first conductive electrode, a second conductive electrode, and a carrier containing the active agent; wherein the first conductive electrode is in electric communication with the second conductive electrode, wherein the first conductive electrode and the second conductive electrode are in ionic communication with the carrier, and wherein the carrier is in communication with the barrier membrane through the barrier membrane contacting surface, wherein the difference of the standard potentials of the first conductive electrode and the second conductive electrode is at least 0.2 V and wherein the electrons that pass between the first conductive electrode and the second conductive electrode are generated as a result of such difference of the standard potentials

■ Process for making supported thin zeolite membrane

- 등록 번호 : 7476635
- 발명자 : Chau, Christophe (Rueil Malmaison, FR), Sicard, Michael (Palaiseau, FR), Le Dred, Ronan (Riedisheim, FR)
- 출원인 : Institut Francais Du Petrole (Rueil Malmaison Cedex, FR)
- 초록 : Described is a process for the preparation of a supported zeolite membrane that consists of a zeolite/substrate composite layer, whose zeolite phase exhibits a crystallinity of at least 85%, comprising: a) the formation of a gel or a solution that comprises at least one source of silica and water,

supplemented with at least one polar organic compound, b) bringing into contact said gel or said solution with a porous substrate, c) the crystallization of the zeolite starting from said gel or said solution; and d) the elimination of residual agents. The molar ratio of the water to the silica in the gel or the solution in stage a) is between 27:1 and 35:1. The crystallization time of stage c) is at least 25 hours. Said process is particularly suited for the preparation of zeolite membranes whose zeolite phase is of the MFI-structural type.

■ Membrane electrode assembly and fuel cell

- 등록 번호 : 7476459
- 발명자 : Wakahoi, Toshiya (Utsunomiya, JP), Komori, Tetsuya (Utsunomiya, JP), Nanaumi, Masaaki (Utsunomiya, JP), Yano, Junichi (Utsunomiya, JP)
- 출원인 : Honda Motor Co., Ltd. (Tokyo, JP)
- 초록 : A membrane electrode assembly includes an anode, a cathode, and a solid polymer electrolyte membrane interposed between the anode and the cathode. The anode and the cathode include gas diffusion layers and electrode catalyst layers. Mixture layers are provided over predetermined areas H around surfaces of the electrode catalyst layers. The electrode catalyst layers and adhesive layers are mixed in the mixture layers, respectively.

■ Process and energy-efficient biological treatment system with filtration membrane

- 등록 번호 : 7476322
- 발명자 : Dimitriou, Michael A. (Richmond, VA, US), Krall, Joseph G. (Grafton, WI, US), Rice, David (Port Washington, WI, US), Yogendran, Velupillai (Warwickshire, GB), Byrne, Roger J. (Mequon, WI, US), George, Kenneth P. (Grafton, WI, US), Koch, III, John E. (Wauwatosa, WI, US)

- 출원인 : ITT Manufacturing Enterprises, Inc. (Wilmington, DE, US)
 - 초록 : A membrane filtration system comprising one or more submerged ultrafiltration or microfiltration membrane assemblies at ambient pressure, with mixed liquor is discharged underneath each membrane assembly. In a sequenced batch reactor system, a coarse bubble air diffuser for scouring each membrane assembly is supplied with air only during the backwash cycle of the filtration system and not during the filtration cycle. In a membrane bioreactor system, the biological treatment section is physically separated from the filtration section and fine bubble air diffusion is used in the biological treatment section.
- **Process for preparing ethyl tert-butyl ether using ethanol dewatered by a membrane process**
- 등록 번호 : 7473808
 - 발명자 : Rix, Armin (Marl, DE), Hoepfer, Frank (Haltern am See, DE), Praefke, Jochen (Oer-Erkenschwick, DE), Bueschken, Wilfried (Haltern am See, DE)
 - 출원인 : OXENO Olefinchemie GmbH (Marl, DE)
 - 초록 : A process for preparing ethyl tert-butyl ether (ETBE) using low-water ethanol obtained by membrane dewatering at least two streams of relatively water-rich ethanol that have a different water content. by dewatering at membranes.
- **Materials for use as proton conducting membranes for fuel cells**
- 등록 번호 : 7473714
 - 발명자 : Einsla, Brian R. (Blacksburg, VA, US), McGrath, James E. (Blacksburg, VA, US)
 - 출원인 : Virginia Tech Intellectual Properties, Inc. (Blacksburg, VA, US)
 - 초록 : A family of polymers having pendent sulfonate moieties connected to polymeric main

chain phenyl groups are described. These polymers are prepared by the steps of polymerization (using a monomer with a phenyl with an alkoxy substitution), deprotection by converting the alkoxy to a hydroxyl, and functionalization of the polymer with a pendant sulfonate group. As an example, sulfonated poly(arylene ether sulfone) copolymers with pendant sulfonic acid groups are synthesized by the direct copolymerization of methoxy-containing poly(arylene ether sulfone)s, then converting the methoxy groups to the reactive hydroxyl form, and finally functionalizing the hydroxyl form with proton-conducting sites through nucleophilic substitution. The family of polymers may have application in proton exchange membranes and in other applications.

■ **Membrane arrays and methods of manufacture**

- 등록 번호 : 7473533
- 발명자 : Carre, Alain R. E. (Le Chatelet-En-Brie, FR), Efremov, Alexander M. (St. Petersburg, RU), Fang, Ye (Painted Post, NY, US), Hong, Yulong (Painted Post, NY, US), Lacarriere, Valerie (Larchant, FR), Lahiri, Joydeep (Painted Post, NY, US), Lai, Fang (Painted Post, NY, US), Mauro, John C. (Painted Post, NY, US), Raghavan, Srikanth (Ithaca, NY, US), Webb, Brian L. (Painted Post, NY, US)
- 출원인 : Corning Incorporated (Corning, NY, US)
- 초록 : The invention relates to G protein-coupled receptor (GPCR) microarrays on porous substrates for structural or functional analyses of GPCRs, and methods of preparing porous substrate surfaces for receiving membranes that comprise GPCRs. In one embodiment, a GPCR microarray of the invention comprises a membrane adhered to an upper surface of a porous substrate, the membrane spanning across a plurality of pores on the porous substrate to form a plurality of cavities having sufficient geometry to permit entry of assay reagents into each cavity, thereby allowing access of assay

reagents to both sides of GPCR in the membrane.

■ **Catalyst-coated membrane, membrane-electrode assembly, and polymer electrolyte fuel cell**

- 등록 번호 : 7473486
- 발명자 : Yoshimura, Mikiko (Hirakata, JP), Hori, Yoshihiro (Ikoma, JP), Tsuji, Yoichiro (Katano, JP), Yoshida, Akihiko (Hirakata, JP), Yonamine, Takeshi (Mino, JP), Uchida, Makoto (Hirakata, JP)
- 출원인 : Panasonic Corporation (Osaka, JP), Asahi Glass Co., Ltd. (Tokyo, JP)
- 초록 : An object of the present invention is to provide a catalyst-coated membrane suitable for achieving a polymer electrolyte fuel cell that sufficiently prevents a decrease in the initial characteristics and also exhibits sufficient cell performance for a long period of time and has excellent durability. In at least the cathode catalyst layer, the ratio (W_P/W_{Cat-C}) of the weight of the polymer electrolyte (W_P) to the weight of the catalyst-carrying carbon (W_{Cat-C}) is decreased from an innermost layer positioned closest to the polymer electrolyte membrane toward an outermost layer positioned farthest from the polymer electrolyte membrane. The ratio (W_P/W_{Cat-C}) in the innermost layer is 0.8 to 3.0, and the ratio (W_P/W_{Cat-C}) in the outermost layer is 0.2 to 0.6.

■ **Rolled membrane with compression spacers**

- 등록 번호 : 7510752
- 발명자 : Robertson, Ross Hartford (Cicero, IN, US)
- 출원인 : BFS Diversified Products, LLC (Indianapolis, IN, US)
- 초록 : A rolled membrane includes a core member and a membrane having a width defined by a first edge and a second edge. The membrane can be rolled around the core member such that the first edge and the sec-

ond edge are exposed. A pre-applied seam tape having a substantially uniform thickness is affixed along the first edge. A first and second compression spacer may be located substantially adjacent to the seam tape and the second edge, respectively. The compression spacers have a thickness at least 0.005 inches greater than the thickness of the seam tape. The compression spacers are configured to allow the seam tape to remain in a substantially uncompressed state when the membrane is rolled and, therefore, avoid damage. The compression spacers allow the membrane to be rolled uniformly on the core member without telescoping and with a uniform cross-sectional diameter along the width of the rolled membrane.

■ **Process to improve the efficiency of a membrane filter activated sludge system**

- 등록 번호 : 7510655
- 발명자 : Barnes, Dennis J. (Oconomowoc, WI, US)
- 출원인 : Siemens Water Technologies Corp. (Warrendale, PA, US)
- 초록 : A process for treating BOD, nitrogen and phosphorus containing wastewater, wherein the process includes the steps of providing wastewater influent into an anoxic zone having activated sludge and mixing the wastewater influent with the activated sludge in the anoxic zone to form a mixed liquor. The process further includes providing the mixed liquor into one more further treatment zones and transferring a portion of the mixed liquor from the further treatment zone to a membrane filter wherein a filtrate is separated from sludge. The process also includes selectively recycling at least a portion of the sludge to the anoxic zone as recycled activated sludge.

■ **Gas separation membrane module assembly**

- 등록 번호 : 7510594
- 발명자 : Wynn, Nicholas P (Palo Alto, CA, US),

Fulton, Donald A. (Fairfield, CA, US)

•출원인 : Membrane Technology and Research, Inc. (Menlo Park, CA, US)

•초록 : A gas-separation membrane module assembly and a gas-separation process using the assembly. The assembly includes a set of tubes, each containing gas-separation membranes, arranged within a housing. The housing contains a tube sheet that divides the space within the housing into two gas-tight spaces. A permeate collection system within the housing gathers permeate gas from the tubes for discharge from the housing

■ **Pressure differential sensor comprising an excess-load membrane**

•등록 번호 : 7509865

•발명자 : Burczyk, Dietfried (Teltow, DE), Dannhauer, Wolfgang (Teltow, DE), Nürnberger, Ralf (Potsdam, DE)

•출원인 : Endress + Hauser GmbH + Co. KG (Maulburg, DE)

•초록 : A pressure difference transducer includes a hydraulic body, in which is formed an overload chamber containing an overload membrane. The overload chamber divides the overload chamber into a high-pressure chamber portion and a low-pressure chamber portion. The high-pressure chamber portion communicates with a first hydraulic path, which extends between a first diaphragm seal and a high-pressure side of a pressure measuring cell, and the low-pressure chamber portion communicates with a second hydraulic path, which extends between a second diaphragm seal and a low-pressure side of the pressure measuring cell. The low-pressure chamber portion has an essentially convex membrane bed, against which the overload membrane lies in a rest position.

■ **Unitized membrane electrode assembly and process for its preparation**

•등록 번호 : 7504174

•발명자 : Lertola, James Gerard (Avondale, PA, US)

•출원인 : E. I. du Pont de Nemours & Company (Wilmington, DE, US)

•초록 : The invention provides a unitized membrane electrode assembly having a first gas diffusion backing having sealing edges; a polymer membrane; a second gas diffusion backing having sealing edges; a first electrocatalyst coating composition present at the interface of the first gas diffusion backing and the polymer membrane; a second electrocatalyst coating composition present at the interface of the second gas diffusion backing and the polymer membrane; and a thermoplastic polymer, fluid impermeable, seal, wherein the thermoplastic polymer is impregnated into the sealing edges of the first and second gas diffusion backings, and the seal envelops a peripheral region of both the first and second gas diffusion backings and the polymer membrane.

■ **Hollow fiber membrane and method of producing the same**

•등록 번호 : 7504034

•발명자 : Minegishi, Shin-Ichi (Shiga, JP), Henmi, Masahiro (Shiga, JP), Ishizaki, Toshiyuki (Shiga, JP), Dan, Koichi (Shiga, JP)

•출원인 : Toray Industries, Inc. (Tokyo, JP)

•초록 : A method of producing a hollow fiber membrane includes discharging a polyvinylidene fluoride solution comprising a polyvinylidene fluoride resin and a poor solvent at a temperature above a phase separation temperature into a cooling bath at a temperature below the phase separation temperature to coagulate the polyvinylidene fluoride resin. The hollow fiber membrane comprises a polyvinylidene fluoride resin having spherical structures that have an average diameter in the range of 0.3 to 30 μm .

■ **Membrane and method for the production of the same**

- 등록 번호 : 7502482
- 발명자 : Dehé, Alfons (Neufahrn, DE), Barzen, Stefan (München, DE), Fuedner, Marc (Neubiberg, DE)
- 출원인 : Infineon Technologies AG (Munich, DE)
- 초록 : In a method for producing a membrane for a device, e.g. a microphone, first, a substrate is provided, whereon a counter electrode is disposed. A sacrificial layer is provided on a surface of the counter electrode facing away from the substrate. The surface of the sacrificial layer facing away from the counter electrode is structured to form a plurality of recesses in the surface to define one or several antistick elements and one or several corrugation grooves at the same time. Subsequently, a membrane material is deposited on the structured surface of the sacrificial layer. Then, the sacrificial layer is removed to form the membrane, which has one or several corrugation grooves and one or several antistick elements.

■ **Method for producing fabric-reinforced capillary membranes, in particular for ultrafiltration**

- 등록 번호 : 7501084
- 발명자 : Vossenkaul, Klaus (Aachen, DE), Schäfer, Stefan (Aachen, DE)
- 출원인 : Koch Membrane Systems GmbH (Aachen, DE)
- 초록 : The invention relates to a method for producing fabric-reinforced capillary membranes, particularly for ultrafiltration, in which a fabric tube (1) is coated with a polymer solution and is guided through a precipitation bath (6), where the polymer solution is converted into a microporous layer in the precipitation bath (6), and a membrane that

is reinforced by the fabric tube is formed. According to the invention, the fabric tube coated with the polymer solution passes through the precipitation bath (6) from top to bottom, without mechanical contact, and exits through a nozzle (7) at the bottom. Liquid flows out of the nozzle (7), which liquid exerts a tensile force stabilizing the course of the coated fabric tube, on the capillary membrane (8) leaving the precipitation bath.

■ **Highly selective membrane systems and methods for protein ultrafiltration**

- 등록 번호 : 7497950
- 발명자 : Sirkar, Kamalesh (Bridgewater, NJ, US), Feins, Meredith (River Vale, NJ, US)
- 출원인 : New Jersey Institute of Technology (Newark, NJ, US)
- 초록 : A new ultrafiltration technique based on a multimembrane stack has been developed to fractionate solutes closer in size than conventionally possible. The technique is illustrated here by obtaining a pure protein product from a binary protein mixture. By employing membranes in series without any gaskets or spacers in-between, ultrafiltration is carried out to separate two proteins relatively close in molecular weight or size. Flat regenerated cellulose membranes, polyethersulfone membranes or the like, of at least substantially the same molecular weight cut-off (MWCO) are stacked together in the desired number, and ultrafiltration takes place. The membrane rejection of a protein is amplified with each additional membrane, ultimately resulting in a completely rejected species. Complete purification of the more permeable protein is achieved regardless of the physicochemical condition which may be optimal or suboptimal for selective separation by a single membrane.

■ **Modified vitamin K-dependent polypeptides**

- 등록번호 : 7553935
- 발명자 : Nelsestuen, Gary L (St. Paul, MN, US)
- 출원인 : Regents of the University of Minnesota (Saint Paul, MN, US)
- 초록 : The invention provides vitamin K-dependent polypeptides with enhanced membrane binding affinity. These polypeptides can be used to modulate clot formation in mammals. Methods of modulating clot formation in mammals are also described.

■ **Cell permeable peptides for inhibition of inflammatory reactions and methods of use**

- 등록번호 : 7553929
- 발명자 : Hawiger, Jack J. (Nashville, TN, US), Robinson, Daniel (Lexington, KY, US), Veach, Ruth Ann (Brentwood, TN, US), Liu, Xue Yan (Nashville, TN, US), Liu, Danya (Nashville, TN, US), Downs, Sheila (Nashville, TN, US), Collins, Robert D. (Nashville, TN, US), Lin, Yao-Zhong (Nashville, TN, US)
- 출원인 : Vanderbilt University (Nashville, TN, US)
- 초록 : The present invention relates to the delivery of biologically active molecules, such as peptides, into the interior of cells by administering to the cells a complex comprising the molecule linked to an importation competent signal peptide. Such delivery can be utilized, for example, to treat and/or prevent inflammatory conditions, e.g., but not limited to, systemic inflammatory reactions such as endotoxic shock, localized inflammatory reactions such as inflammatory skin diseases and conditions, and inflammatory diseases such as autoimmune diseases.

■ **Extraction of integral membrane proteins**

- 등록번호 : 7553634

- 발명자 : Lakhota, Sanjay (Danville, CA, US), Biehl, Michael R. (Sanford, NC, US)
- 출원인 : Wyeth Holdings Corporation (Madison, NJ, US)
- 초록 : A process is described for extracting gram-negative integral membrane proteins from bacteria or bacterial host cells containing a recombinant vector by differential detergent tangential flow diafiltration. This process has several advantages over alternate processes. First, it combines the clarification and extraction processes into one unit operation. The product is extracted from the cells and it is separated from cell debris with only one continuous diafiltration process. Second, the membrane proteins are extracted in a semi-purified state, which simplifies the downstream processing steps. Third, this process is very scalable because the only requirement is that the surface area of the membranes be increased proportionally with the amount of cells

■ **Method for cryopreserving microencapsulated living animal cells enclosed in immunoisolation membranes, such microencapsulated living animal cells in immunoisolation membranes, and biohybrid artificial organ modules using such microencapsulated living animal cells in immunoisolation membranes**

- 등록번호 : 7553612
- 발명자 : Aoki, Takeshi (Setagaya-ku, JP), Kusano, Mitsuo (Ohta-ku, JP), Shimizu, Yoshinori (Ohta-ku, JP), Koizumi, Tomotake (Shinagawa-ku, JP), Yasuda, Daisuke (Ohta-ku, JP), Izumida, Yoshihiko (Chiyoda-ku, JP), Murai, Noriyuki (Ohta-ku, JP), Jin, 코두호매 (Shinagawa-ku, JP), Kobayashi, Yasuna (Shinagawa-ku, JP), Kato, Hirohisa (Shinagawa-ku, JP), Hua, Luchun, (Shanghai, JP)
- 출원인 : Showa University (Tokyo, JP)
- 초록 : A method is disclosed for cryopreserving living animal cells in immunoisolation mem-

branes, including: (1) cutting out a living organ from an animal, (2) digesting the cutout organ into the discrete living animal cells and separating the discrete cells, (3) suspending the separated cells in a solution of sodium chloride containing sodium alginate and collagen, (4) forming microcapsules of the living animal cells by using the resulting suspension, (5) forming immunoisolation membranes around outer surfaces of the microcapsules of the living animal cells by covering the outer surfaces with alginate-(poly-L-lysine) and thereby obtaining the living animal cells enclosed in the immunoisolation membranes, (6) suspending the resulting living animal cells enclosed in the immunocapsules in a cell damage-preventing solution, and (7) immediately freezing the thus obtained suspension with liquid nitrogen.

■ **Non-aqueous electrolyte secondary battery and method of manufacturing the same**

- 등록번호 : 7553587
- 발명자 : Watanabe, Kozo (Osaka, JP)
- 출원인 : Panasonic Corporation (Osaka, JP)
- 초록 : A non-aqueous electrolyte secondary battery has an insulating porous membrane, on at least one of a positive electrode, negative electrode, and separator thereof. The membrane contains an inorganic filler, and an active agent for dispersing the inorganic filler uniformly.

■ **Fuel cell membrane electrode assembly with sealing surfaces**

- 등록번호 : 7553578
- 발명자 : Wald, David Allen (Lakeland, MN, US), Le, Jimmy Minh (Saint Paul, MN, US), Yandrasits, Michael Andrew (Hastings, MN, US), Boucher, Paul Michael (Saint Paul, MN, US)
- 출원인 : 3M Innovative Properties Company

(Saint Paul, MN, US)

- 초록 : The present invention provides a method of making a gasketed fuel cell membrane electrode assembly by simultaneously binding together the parts of the MEA, impregnating uncured elastomeric gasket material into the outer edge portions of each fluid transport layer, and substantially curing the uncured elastomeric gasket material so as to form anode-side and cathode-side gaskets. In order to form a raised-ridge microstructured contact pattern on the contact face of each gasket, patterning plates bearing a negative relief of a raised-ridge microstructured contact pattern may be positioned between the press platens and the uncured elastomeric gasket material.

■ **Irreversible humidity exposure dose indicator device**

- 등록번호 : 7553450
- 발명자 : Attar, Amir J. (Raleigh, NC, US), Stark, Dan Edward (Raleigh, NC, US)
- 출원인 : Appealing Products, Inc. (Raleigh, NC, US)
- 초록 : An irreversible humidity exposure dose indicator device, including a housing sealed at a first end thereof and adapted at a second end thereof to admit ambient gas ingress into an interior volume containing chromogenic material. The chromogenic material in contact with water irreversibly absorbs such water to produce a change whose extent is correlative of cumulative exposure of the device to humidity. The device may be configured as an indicator card including an intermediate permeable membrane coated on a first side thereof with a layer of a deliquescent solid and being in contact on a second side thereof with a layer containing a reactive indicator, with a water-permeable layer adjacent to the layer containing the deliquescent coating, enclosed within a water-impermeable transparent enclosure. The device can include an opening to the permeable layer

that is shielded by a removable member that is removed to initiate the dosimetric process, and permit water vapor to diffuse through the opening and liquefy the deliquescent material, so that the liquid permeates through the membrane and a visible indication of the location of

the wet front is seen as the water contacts the chromogenic material. A scale can be printed on the exterior of the enclosure to permit a viewer to see the progress of the indication, e. g. of a color front.