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(54) **POLYMER COMPOSITE MATERIALS FOR BUILDING AIR CONDITIONING OR DEHUMIDIFICATION AND PREPARATION METHOD THEREOF**

POLYMERVERBUNDMATERIALIEN FÜR DIE KLIMAAANLAGE ODER ENTFEUCHTUNG EINES GEBÄUDES UND HERSTELLUNGSVERFAHREN DAFÜR

MATÉRIAUX POLYMÈRES COMPOSITES POUR LE CONDITIONNEMENT OU LA DÉSHUMIDIFICATION DE L'AIR DES BÂTIMENTS ET LEUR PROCÉDÉ DE PRÉPARATION

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Description

[Technical Field]

[0001] The present disclosure relates to polymer composite materials for building air conditioning or dehumidification and a method for preparing the same. More particularly, the present disclosure relates to the preparation of high-efficiency composite materials for building air conditioning or dehumidification having superior antibacterial properties and durability as well as excellent water adsorption/desorption ability due to a large surface area by electrospinning of a polymer composite material solution with a crosslinking agent or a crosslinking agent and a porous filler added to a hydrophilic polymer solution to prepare a fiber sheet composed of fibers having a nano or a submicron scale diameter followed by crosslinking.

[Background Art]

[0002] Recently, government regulations have been instituted which require air conditioning systems to perform decontamination functions in addition to basic air conditioning functions. Air conditioning of a building includes heating, cooling, ventilation and heat exchange. Quality air conditioning provides a healthy and comfortable environment, improves satisfaction with the indoor environment and enhances productivity. Two heat loads - sensible heat and latent heat - determine the capacity of an air conditioning system. The latent heat load accounts for 30-50% of the total heat load. The sensible heat means the heat exchanged during a change of temperature, whereas the latent heat refers to the heat that cannot be observed as a change of temperature, e.g. heat absorbed during the phase change of water. A phase change of water without change of temperature results in an air conditioning load. If water is removed from the air using an air conditioning material, the size and energy consumption of an air conditioner may be reduced since the dehumidification/cooling system needs only to address the sensible heat load.

[0003] The air conditioning system includes a total heat exchanger for a ventilation unit, a dehumidification rotor for dehumidification/cooling, a rotor-type total heat exchanger, or the like. Fig. 1 shows a rotor-type total heat exchanger, illustrating a process whereby air is supplied from outside and indoor air is exhausted outside. After water is absorbed from the indoor air to be exhausted in order to reduce the latent heat load, a water-absorbent polymer composite material exchanges heat with water in the air supplied from outside and supplies the air indoors while the rotor-type total heat exchanger rotates, thus providing cool air and ventilation with reduced energy consumption.

[0004] Current studies on building air conditioning materials focus only upon general water absorbents using super-dense paper, inorganic materials, metal silicates, silica gel, zeolite, or the like. For example, Japan's Seibu

Giken has developed water-absorbent polymer powder and is marketing a total heat exchanger with the water-absorbent polymer powder impregnated in or coated on a metal sheet. However, since the water-absorbent polymer powder adsorbs water through hydration by ions, not by pores, pollutant molecules are discharged into the air without being adsorbed.

[0005] Recently, demand for high-efficiency composite materials for building air conditioning or dehumidification having antibacterial properties as well as excellent water absorbing ability and being easily applicable to various designs is increasing.

[0006] KR 2010 0000093 A discloses a manufacturing method of a honeycomb structure for an air-to-air heat exchanger.

[Disclosure]

[Technical Problem]

[0007] Aspects of the present disclosure are directed to high-efficiency composite materials for building air conditioning or dehumidification having antibacterial properties as well as excellent water absorbing ability and being easily applicable to various designs.

[Technical Solution]

[0008] The present disclosure provides a method for preparing a polymer composite material for building air conditioning or dehumidification with the features of claim 1.

[Advantageous Effects]

[0009] According to the present disclosure, the polymer composite material for building air conditioning or dehumidification has superior antibacterial properties and excellent water-adsorbing ability and durability. As a result, the polymer composite material may control humidity when used for air conditioning of a building, thereby reducing air conditioning load and improving energy efficiency. In addition, the polymer composite material may prevent various diseases and allows supply of pleasant indoor air. Further, through dehumidifying/cooling, the polymer composite material may remove moisture from hot and humid air in the summer, thus reducing air conditioning load by decreasing latent heat load and saving energy. Furthermore, the high-efficiency polymer composite material may be used in moisture-sensitive production processes or industrial applications requiring moisture control or protection from damage or corrosion by moisture in order to dehumidify and provide dry air.

[0010] The polymer composite material according to the present disclosure may be utilized for water adsorption and dehumidification in various fields, for example, in building air conditioning and dehumidification/cooling, including a total heat exchanger of a ventilation unit, a

dehumidification rotor for dehumidification/cooling and a rotor-type total heat exchanger.

[Description of Drawings]

[0011] The above and other aspects, features and advantages of the present disclosure will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 shows a total heat-exchange rotor according to an embodiment of the present disclosure;
 Fig. 2 illustrates a crosslinking mechanism of a PVA polymer in Example 1;
 Fig. 3 shows scanning electron micrographs of a PVA nanofiber sheet, a crosslinked sheet and a zeolite-introduced nanofiber sheet in Example 1;
 Fig. 4 shows water adsorption by a nanofiber sheet in Example 2;
 Fig. 5 shows the amount of polymer remaining after washing as compared to the initial polymer amount in Examples 2-4, as a measure of durability;
 Fig. 6 shows a result of culturing *E. coli* at 35°C for 24 hours in Examples 5-7, in order to evaluate antibacterial properties; and
 Fig. 7 shows a result of culturing salmonella at 35°C for 24 hours in Examples 5-7, in order to evaluate antibacterial properties.

[Best Mode]

[0012] Exemplary embodiments of the present disclosure will now be described.

[0013] In one embodiment, a method for preparing a polymer composite material for building air conditioning or dehumidification according to the present disclosure includes: (S1) adding a crosslinking agent or a crosslinking agent and a porous filler for conferring durability and antibacterial properties into a hydrophilic polymer solution to prepare a polymer composite material solution; (S2) electrospinning the polymer composite material solution to prepare a nanofiber sheet; and (S3) crosslinking the nanofiber sheet by heat-treatment.

[0014] In step S1, a crosslinking agent or a crosslinking agent and a porous filler are added to a hydrophilic polymer solution in order to confer durability and antibacterial properties, thereby preparing a polymer composite material solution. The hydrophilic polymer solution may be prepared by dissolving at least one hydrophilic polymer selected from the group consisting of polyvinyl alcohol (PVA), polystyrene sulfonic acid, polystyrene sulfonic acid/maleic acid copolymer, sodium polystyrene sulfonate, polyacrylate, polyethylene glycol, polyethylene oxide, cellulose derivatives, and ion exchange resins in at least one solvent selected from the group consisting of water, alcohol, DMF, NMP and DMAc. The content of the hydrophilic polymer may be 0.5 to 50 wt% based on the weight of the hydrophilic polymer solution. If the hy-

drophilic polymer content exceeds 50 wt%, the resulting high viscosity may prevent effective electrospinning. Conversely, if the hydrophilic polymer content is below 0.5 wt%, nanofiber may not be produced because of low viscosity.

[0015] This step may include: dissolving a hydrophilic polymer in a solvent to prepare a first solution; dissolving another hydrophilic polymer different from the first hydrophilic polymer in a solvent to prepare a second solution; and mixing the first solution and the second solution to prepare the hydrophilic polymer solution.

[0016] The proportion of the contents of the hydrophilic polymers in the hydrophilic polymer solution is not particularly limited and may be appropriately adjusted considering required physical properties.

[0017] The crosslinking agent added to improve durability and antibacterial properties may include at least one selected from the group consisting of peroxides such as dibenzoyl peroxide, inorganic precursors such as tetraethyl orthosilicate, silane coupling agents such as 3,3-diethoxypropyltriethoxysilane, aldehydes such as glutaraldehyde, polyacrylic acids, diisocyanates, diacids and derivatives thereof, and organic acids containing a sulfonic acid group. Particularly, an organic acid containing a sulfonic acid group selected from the group consisting of sulfosuccinic acid (SSA), polystyrene sulfonic acid and poly(4-styrenesulfonic acid-co-maleic acid) sodium salt may be used.

[0018] The porous filler added to improve durability and antibacterial properties may be zeolite, SBA-15, MCM-41, silica gel, carbon, carbon nanotube, or the like. Further, a porous filler substituted with metal ions such as Cu or Ag may also be used.

[0019] The content of the crosslinking agent in the polymer composite material solution may be 20 wt% or less based on the weight of the hydrophilic polymer. If the content of the crosslinking agent exceeds 20 wt%, the resulting polymer composite material may be too hard or brittle.

[0020] In addition, the content of the porous filler in the polymer composite material solution may be 50 wt% or less based on the weight of the hydrophilic polymer. If the content of the porous filler exceeds 50 wt%, the filler may not be dispersed well but coagulate. Further, the amount or rate of water adsorption may decrease.

[0021] In step S2, electrospinning is carried out. By electrospinning the polymer composite material solution using an electric field after injecting the solution into a syringe or capillary tube, a nanofiber sheet with increased surface area may be prepared. By applying a high-voltage electric field during electrospinning, a nanofiber structure may be more effectively formed. In addition, by controlling the viscosity of the polymer composite material solution, the applied voltage, spinning distance, or the like, the diameter of the nanofiber may be adjusted. The nanofiber may have a diameter ranging from tens of nanometers to tens of micrometers. Thus, the surface area of the composite material sheet may be controlled

to confer a very large water adsorbing capacity.

[0022] In step S3, the nanofiber sheet prepared in step S2 is crosslinked by heat treatment. The crosslinking is initiated by heating and performed while maintaining the elevated temperature. In the case where a metal peroxide is used as the crosslinking agent, the solution is left at room temperature for predetermined time and then the crosslinking is performed in the same manner.

[0023] Before or after step S3, the nanofiber sheet may be adhered to a metal sheet, a ceramic fiber sheet or a conductive polymer film. A metal sheet such as aluminum sheet or stainless steel sheet, a ceramic fiber sheet, or a conductive polymer film such as polyvinyl chloride may be adhered to the crosslinked polymer composite material sheet or to the nanofiber sheet prior to crosslinking. Further, an adhesive may be applied on the surface of the metal sheet and the nanofiber sheet may be adhered to either or both sides of the metal sheet.

[0024] In another embodiment, a method for preparing a polymer composite material for building air conditioning or dehumidification according to the present disclosure comprises: (S1) adding a crosslinking agent or a crosslinking agent and a porous tiller for conferring durability and antibacterial properties into a hydrophilic polymer solution to prepare a polymer composite material solution; (S2) electrospinning the polymer composite material solution directly onto a metal sheet, a ceramic fiber sheet or a conductive polymer film to prepare a nanofiber sheet; and (S3) crosslinking the nanofiber sheet by heat-treatment. This embodiment is the same as the above embodiment, except that the nanofiber sheet is prepared by directly electrospinning the polymer composite material solution onto the metal sheet, the ceramic fiber sheet or the conductive polymer film.

[0025] The polymer composite material for building air conditioning or dehumidification according to the present disclosure may be used for various applications, including a total heat exchanger for a ventilation unit, a dehumidification rotor for dehumidification/cooling, a rotor-type total heat exchanger, and the like. The total heat exchanger for a ventilation unit is a rectangular-shaped heat exchanger fabricated using an insulating exchange membrane with superior water permeability. An insulating exchange membrane that transmits water but blocks polluted air is prepared in the form of a honeycomb. The total heat exchanger transmits latent heat of water included in the air through the paper insulating membrane to the introduced air during ventilation, thereby lowering indoor temperature and humidity, removes fine dust such as pollen, thereby preventing various diseases, is installed in the ceiling, thereby minimizing noise and providing a quiet environment, provides excellent ventilation through forced ventilation in both directions using separate exhaust and inlet vents, and supplies cleanly filtered fresh outside air, rather than recirculated the indoor air, thereby maintaining a pleasant indoor environment.

[0026] The dehumidification rotor for dehumidification/cooling is a key component of a dehumidifica-

tion/cooling system, which is used to dehumidify the hot and humid summer air through low-energy cooling by separating the latent heat load and the sensible heat load. Further, it is used to dehumidify the air for the purpose of cooling and drying of products, quality improvement and maintenance, humidity control of a production process, or the like. Specific applications include moisture-sensitive production processes such as pharmaceutical, electronic or food production processes or fields requiring prevention of damage or corrosion by moisture, to remove moisture in the air and provide a dry environment.

[0027] The rotor-type total heat exchanger is a high-efficiency, energy-saving device capable of controlling thermal balance associated with introduction and exhaust of indoor and outdoor air, effectively purifying indoor air, and reducing cooling/heating load. The rotor-type total heat exchanger may be utilized as a heat recovery ventilator for forced air supply/discharge by reducing the latent heat of water in the exhausted air during ventilation and exchanging heat with the water in the air supplied from outside, without requiring an additional heating or cooling source. The absorbent of the rotor-type total heat exchanger, which serves as a latent heat exchange medium, is impregnated in, coated on or adhered to a cylindrical honeycomb structure. The polymer composite material for building air conditioning of the present disclosure may be used as the latent heat exchange medium employed in the honeycomb structure.

[0028] The polymer composite material for building air conditioning or dehumidification according to the present disclosure has superior water-adsorbing ability because of the increased surface area and the hydration by ions, and has excellent durability and antibacterial properties. Thus, when used to air condition a building, it may reduce the latent heat load of water included in the indoor air, thereby saving energy by reducing air conditioning load and supplying pleasant indoor air. Further, when used for dehumidification/cooling, it can remove moisture from hot and humid air, thus reducing air conditioning load by decreasing the latent heat load and saving energy. In addition, it may be used in moisture-sensitive production processes or industrial applications requiring moisture control or protection from damage or corrosion by moisture in order to dehumidify and provide dry air. Accordingly, the present disclosure is applicable to various fields for water adsorption and dehumidification.

[Mode for Invention]

[0029] Hereinafter, Examples of the present disclosure will be described in detail.

Example 1

[0030] A polyvinyl alcohol (PVA) solution was prepared by dissolving PVA (87~89% hydrolyzed, Sigma-Aldrich) in distilled water to 10 wt% at 60°C. After adding sulfo-succinic acid (SSA, Aldrich) to the PVA solution as a

crosslinking agent in an amount of 20 wt% based on the weight of PVA, the mixture was stirred for over 1 hour. Then, zeolite A was added in an amount of 1 wt% based on the weight of PVA to prepare a polymer composite material solution.

[0031] The prepared polymer composite material solution was electrospun using an electrospinning apparatus (NT-PS-35K, NTSEE Co., Korea) to prepare a polymer nanofiber sheet. The voltage used for the electrospinning was 20 kV, and the distance between the positively charged syringe needle and the negatively charged collector was 18 cm. The syringe used to hold the spinning solution was a 10 mL glass syringe, and the diameter of the syringe needle was 0.5 mm. The feed rate of the solution was 0.7 mL/hr, and the collector rotation speed was 300 rpm. The thickness of the nanofiber sheet was controlled by adjusting spinning time. The nanofiber sheet prepared in this example had a thickness of 30 μm .

[0032] The prepared nanofiber sheet was subjected to crosslinking by heating at 120°C for 1 hour. The associated crosslinking mechanism is illustrated in Fig. 2. Also, the nanofiber sheet was observed using a scanning electron microscope (SEM, Hitachi S-4700). Scanning electron micrographs of the PVA nanofiber sheet, the crosslinked sheet and the zeolite-introduced nanofiber sheet are shown in Fig. 3.

[0033] The water adsorption rate of the nanofiber sheet was measured. Experiments were performed according to the KS standard for heat exchange efficiency measurement. The diffusion coefficient was calculated from Fick's law. Under the condition of 30°C and relative humidity 60%, the water adsorption rate was $2.48 \times 10^{-11} \text{ cm}^2/\text{s}$ for the PVA nanofiber sheet and $2.96 \times 10^{-11} \text{ cm}^2/\text{s}$ for the 1% zeolite-introduced nanofiber sheet.

Examples 2 to 4

[0034] A PVA solution was prepared by dissolving PVA (87~89% hydrolyzed, Sigma-Aldrich) in distilled water to 10 wt% at 60°C. A 10 wt% polystyrene sulfonic acid-maleic acid copolymer (PSSA-MA, Sigma-Aldrich) solution was prepared separately using distilled water. Thus prepared 10 wt% PVA solution and 10 wt% PSSA-MA solution were mixed at 9:1 (Example 2), 8:2 (Example 3) or 7:3 (Example 4), based on PVA:PSSA-MA, and then stirred to prepare a PVA/PSSA-MA solution. After adding SSA (Aldrich) to the resultant mixture solution as a crosslinking agent in an amount of 20 wt% based on the weight of PVA, the mixture was stirred for over 1 hour.

[0035] The prepared polymer composite material solution was electrospun using an electrospinning apparatus (NT-PS-35K, NTSEE Co., Korea) to prepare a polymer nanofiber sheet. The voltage used for the electrospinning was 20 kV, and the distance between the positively charged syringe needle and the negatively charged collector was 18 cm. The syringe used to hold the spinning solution was a 10 mL glass syringe, and the diameter of the syringe needle was 0.5 mm. The feed rate of the

solution was 0.7 mL/hr, and the collector rotation speed was 300 rpm. The thickness of the nanofiber sheet was controlled by adjusting spinning time. The prepared nanofiber sheet was subjected to crosslinking by heating at 120°C for 1 hour.

[0036] The water adsorption rate of the nanofiber sheet was measured and the results are shown in Fig. 4. Experiments were performed according to the KS standard for heat exchange efficiency measurement. The diffusion coefficient was calculated from Fick's law. The results show that the water adsorption rate was increased above the anticipation through the crosslinking reaction by addition of SSA. Under the condition of 30°C and relative humidity 60%, the adsorption rate of the sample of Example 2 was $2.59 \times 10^{-9} \text{ cm}^2/\text{s}$ before the crosslinking and $1.79 \times 10^{-8} \text{ cm}^2/\text{s}$ after the crosslinking.

[0037] To evaluate durability of the nanofiber sheets prepared in these examples, each of the nanofiber sheets was washed for 1 hour using distilled water at 60°C. After washing, the amount of remaining polymer was calculated as a percentage of the initial polymer amount. Results are shown in Fig. 5. The sample of Example 2 is denoted as "1", the sample of Example 3 is denoted as "2", and the sample of Example 4 is denoted as "3". It can be seen that use of the crosslinking agent resulted in a remarkable improvement in durability.

Examples 5 to 7

[0038] A PVA solution was prepared by dissolving PVA (87~89% hydrolyzed, Sigma-Aldrich) in distilled water to 10 wt% at 60°C. A 10 wt% PSSA-MA (Sigma-Aldrich) solution was prepared separately using distilled water. The prepared 10 wt% PVA solution and 10 wt% PSSA-MA solution were mixed 9:1 (Example 5), based on PVA:PSSA-MA, and then stirred to prepare a PVA/PSSA-MA solution. Further, after adding SSA (Aldrich) to the resultant solution as a crosslinking agent in an amount of 20 wt% based on the weight of PVA, the mixture was stirred for over 1 hour to prepare a polymer solution (Example 6). Then, zeolite A was added thereto in an amount of 1 wt% based on the polymer weight to prepare a polymer composite material solution (Example 7).

[0039] In order to evaluate antibacterial properties, *E. coli* and salmonella bacteria were cultured in the prepared polymer composite material solutions. After culturing at 35°C for 24 hours, photographs were taken to evaluate the antibacterial properties. For measurement of the antibacterial properties against *E. coli*, *E. coli* samples were cultured separately. Results are shown in Fig. 6. The sample of Example 5 is denoted as "1", the sample of Example 6 is denoted as "3", and the sample of Example 7 is denoted as "4". Some *E. coli* was observed in the sample of Example 5, but none was observed in Example 6 or Example 7. When the experiment was performed repeatedly, very slight *E. coli* was found from the sample of Example 6. Fig. 7 shows the result of culturing

salmonella bacteria. In the figure, the right side shows the result when only the bacteria were cultured, and the left side shows the result when the polymer solution was used. Some salmonella bacteria were observed in Example 5, but none was observed in Example 6 or Example 7. Even when the experiment was performed repeatedly, no salmonella bacteria was observed in Example 6 or Example 7. Thus, it was confirmed that the addition of the crosslinking agent and the porous filler results in far superior antibacterial properties.

Claims

1. A method for preparing a polymer composite material for building air conditioning or dehumidification, comprising:

(S1) adding a crosslinking agent and a porous filler for conferring durability and antibacterial properties into a hydrophilic polymer solution to prepare a polymer composite material solution; (S2) electrospinning the polymer composite material solution to prepare a nanofiber sheet; and (S3) crosslinking the nanofiber sheet by heat-treatment, the method further comprising: adhering the nanofiber sheet to a metal sheet, a ceramic fiber sheet or a conductive polymer film before or after heat treatment,

characterized by performing said crosslinking by heating the prepared nanofiber sheet at 120 °C for 1 hour.

2. The method according to claim 1, wherein, in step S1, the hydrophilic polymer solution is prepared by dissolving a hydrophilic polymer in a solvent.
3. The method according to claim 1, wherein, in step S1, the hydrophilic polymer solution is prepared by the steps of comprising: dissolving a hydrophilic polymer in a solvent to prepare a first solution; dissolving another hydrophilic polymer different from the hydrophilic polymer in a solvent to prepare a second solution; and mixing the first solution and the second solution to prepare the hydrophilic polymer solution.
4. The method according to claim 2, wherein the solvent is at least one selected from the group consisting of water, alcohol, DMF, NMP and DMAc.
5. The method according to claim 2, wherein the hydrophilic polymer is selected from the group consisting of polyvinyl alcohol (PVA), polystyrene sulfonic acid, polystyrene sulfonic acid/maleic acid copolymer, sodium polystyrene sulfonate, polyacrylate,

polyethylene glycol, polyethylene oxide, cellulose derivatives, and ion exchange resins.

6. The method according to claim 2, wherein the hydrophilic polymer is present in an amount of 0.5 to 50 wt% based on a weight of the hydrophilic polymer solution.
7. The method according to claim 1, wherein the hydrophilic polymer is polyvinyl alcohol.
8. The method according to claim 1, wherein the crosslinking agent is at least one selected from the group consisting of: peroxides, inorganic precursors and silane coupling agents, aldehydes, polyacrylic acids, diisocyanates, diacids and derivatives thereof, and organic acids containing a sulfonic acid group.
9. The method according to claim 8, wherein the organic acid containing the sulfonic acid group is selected from the group consisting of sulfosuccinic acid (SSA), polystyrene sulfonic acid and poly(4-styrenesulfonic acid-co-maleic acid) sodium salt.
10. The method according to claim 8, wherein the crosslinking agent is present in an amount of 20 wt% or less based on a weight of the hydrophilic polymer.
11. The method according to claim 1, wherein the porous filler is zeolite, SBA-15, MCM-41, silica gel, carbon, carbon nanotube, or a porous filler substituted with Cu or Ag.
12. The method according to claim 1, wherein the porous filler is present in an amount of 50 wt% or less based on a weight of the hydrophilic polymer.

Patentansprüche

1. Ein Verfahren zur Herstellung eines Polymerverbundmaterials für die Gebäudeklimatisierung oder -entfeuchtung, umfassend:

(S1) Hinzufügen eines Vernetzungsmittels und eines porösen Füllstoffs zur Verleihung von Haltbarkeit und antibakteriellen Eigenschaften in eine hydrophile Polymerlösung, um eine Polymerverbundmateriallösung herzustellen; (S2) Elektrospinnen der Polymerverbundmateriallösung, um eine Nanofaserplatte herzustellen; und (S3) Vernetzen der Nanofaserplatte durch Wärmebehandlung, wobei das Verfahren ferner umfasst: Anhaften der Nanofaserplatte an eine Metallplatte, eine Keramikfaserplatte oder einen leitfähigen Poly-

merfilm vor oder nach der Wärmebehandlung,

dadurch gekennzeichnet, dass die Vernetzung durch Erhitzen der vorbereiteten Nanofaserplatte bei 120 °C für 1 Stunde durchgeführt wird.

2. Das Verfahren nach Anspruch 1, wobei in Schritt S1 die hydrophile Polymerlösung durch Auflösen eines hydrophilen Polymers in einem Lösungsmittel hergestellt wird. 5
3. Das Verfahren nach Anspruch 1, wobei in Schritt S1 die hydrophile Polymerlösung durch die folgenden Schritte hergestellt wird: Auflösen eines hydrophilen Polymers in einem Lösungsmittel, um eine erste Lösung herzustellen; Auflösen eines anderen hydrophilen Polymers, das sich von dem hydrophilen Polymer unterscheidet, in einem Lösungsmittel, um eine zweite Lösung herzustellen; und Mischen der ersten Lösung und der zweiten Lösung, um die Lösung des hydrophilen Polymers herzustellen. 10 15 20
4. Das Verfahren nach Anspruch 2, wobei das Lösungsmittel mindestens eines ausgewählt aus der Gruppe bestehend aus Wasser, Alkohol, DMF, NMP und DMAc ist. 25
5. Das Verfahren nach Anspruch 2, wobei das hydrophile Polymer ausgewählt ist aus der Gruppe bestehend aus Polyvinylalkohol (PVA), Polystyrolsulfonsäure, Polystyrolsulfonsäure/Maleinsäure-Copolymer, Natriumpolystyrolsulfonat, Polyacrylat, Polyethylenglykol, Polyethylenoxid, Cellulosederivaten und Ionenaustauschharzen. 30 35 40
6. Das Verfahren nach Anspruch 2, wobei das hydrophile Polymer in einer Menge von 0,5 bis 50 Gew.-%, bezogen auf ein Gewicht der hydrophilen Polymerlösung, vorhanden ist. 45
7. Das Verfahren nach Anspruch 1, wobei das hydrophile Polymer Polyvinylalkohol ist. 50
8. Das Verfahren nach Anspruch 1, wobei das Vernetzungsmittel mindestens eines ausgewählt ist aus der Gruppe bestehend aus: Peroxiden, anorganischen Prekursoren und Silan-Kupplungsmitteln, Aldehyden, Polyacrylsäuren, Diisocyanaten, Diaziden und Derivaten davon und organischen Säuren, die eine Sulfonsäuregruppe enthalten. 55
9. Das Verfahren nach Anspruch 8, wobei die organische Säure, die die Sulfonsäuregruppe enthält, ausgewählt ist aus der Gruppe bestehend aus Sulfobernsteinsäure (SSA), Polystyrolsulfonsäure und Poly(4-styrolsulfonsäure-co-maleinsäure)-Natrium-

salz.

10. Das Verfahren nach Anspruch 8, wobei das Vernetzungsmittel in einer Menge von 20 Gew.-% oder weniger, bezogen auf ein Gewicht des hydrophilen Polymers, vorhanden ist.
11. Das Verfahren nach Anspruch 1, wobei der poröse Füllstoff Zeolith, SBA-15, MCM-41, Kieselgel, Kohlenstoff, Kohlenstoff-Nanoröhrchen oder ein mit Cu oder Ag substituierter poröser Füllstoff ist.
12. Das Verfahren nach Anspruch 1, wobei der poröse Füllstoff in einer Menge von 50 Gew.-% oder weniger, bezogen auf ein Gewicht des hydrophilen Polymers, vorhanden ist.

Revendications

1. Un procédé de préparation d'un matériau polymère composite pour le conditionnement ou la déshumidification de l'air des bâtiments, comprenant :

(S1) l'ajout d'un agent de réticulation et d'une charge poreuse afin de conférer une durabilité et des propriétés antibactériennes à une solution de polymère hydrophile pour préparer une solution de matériau polymère composite ;
(S2) l'électrofilage de la solution de matériau polymère composite pour préparer une feuille de nanofibres ; et
(S3) la réticulation de la feuille de nanofibres par traitement thermique,
le procédé comprenant en outre : l'adhésion de la feuille de nanofibres sur une feuille métallique, une feuille de fibres de céramique ou un film polymère conducteur avant ou après le traitement thermique,

caractérisé par une réalisation de ladite réticulation en chauffant la feuille de nanofibres préparée à 120 °C pendant 1 heure.

2. Le procédé selon la revendication 1, dans lequel, dans l'étape S1, la solution polymère hydrophile est préparée en dissolvant un polymère hydrophile dans un solvant.
3. Le procédé selon la revendication 1, dans lequel, dans l'étape S1, la solution polymère hydrophile est préparée par les étapes comprenant :

la dissolution d'un polymère hydrophile dans un solvant pour préparer une première solution ;
la dissolution d'un autre polymère hydrophile, différent du polymère hydrophile, dans un solvant pour préparer une seconde solution ; et

le mélange de la première solution et de la seconde solution pour préparer la solution polymère hydrophile.

4. Le procédé selon la revendication 2, dans lequel le solvant est au moins un solvant choisi dans le groupe constitué par l'eau, un alcool, le DMF, la NMP et le DMAc. 5
5. Le procédé selon la revendication 2, dans lequel le polymère hydrophile est choisi dans le groupe constitué de l'alcool polyvinylique (PVA), de l'acide polystyrène sulfonique, du copolymère acide polystyrène sulfonique/acide maléique, du polystyrène sulfonate de sodium, du polyacrylate, du polyéthylène glycol, de l'oxyde de polyéthylène, de dérivés de la cellulose, et de résines échangeuses d'ions. 10 15
6. Le procédé selon la revendication 2, dans lequel le polymère hydrophile est présent dans une quantité de 0,5 à 50 % en poids sur la base du poids de solution polymère hydrophile. 20
7. Le procédé selon la revendication 1, dans lequel le polymère hydrophile est l'alcool polyvinylique. 25
8. Le procédé selon la revendication 1, dans lequel l'agent de réticulation est au moins un agent choisi dans le groupe constitué : des peroxydes, d'agents précurseurs inorganiques et de couplage silane, d'aldéhydes, d'acides polyacryliques, de diisocyanates, de diacides et de dérivés de ceux-ci, et d'acides organiques contenant un groupe acide sulfonique. 30 35
9. Le procédé selon la revendication 8, dans lequel l'acide organique contenant le groupe acide sulfonique est choisi dans le groupe constitué de l'acide sulfosuccinique (SSA), de l'acide polystyrène sulfonique et du sel de sodium de l'acide poly(4-styrène sulfonique-co-acide maléique). 40
10. Le procédé selon la revendication 8, dans lequel l'agent de réticulation est présent dans une quantité de 20 % en poids ou moins sur la base du poids de polymère hydrophile. 45
11. Le procédé selon la revendication 1, dans lequel la charge poreuse est de la zéolite, du SBA-15, du MCM-41, du gel de silice, du carbone, du carbone en nanotubes, ou une charge poreuse substituée avec du Cu ou de l'Ag. 50
12. Le procédé selon la revendication 1, dans lequel la charge poreuse est présente dans une quantité de 50 % en poids ou moins sur la base du poids de polymère hydrophile. 55

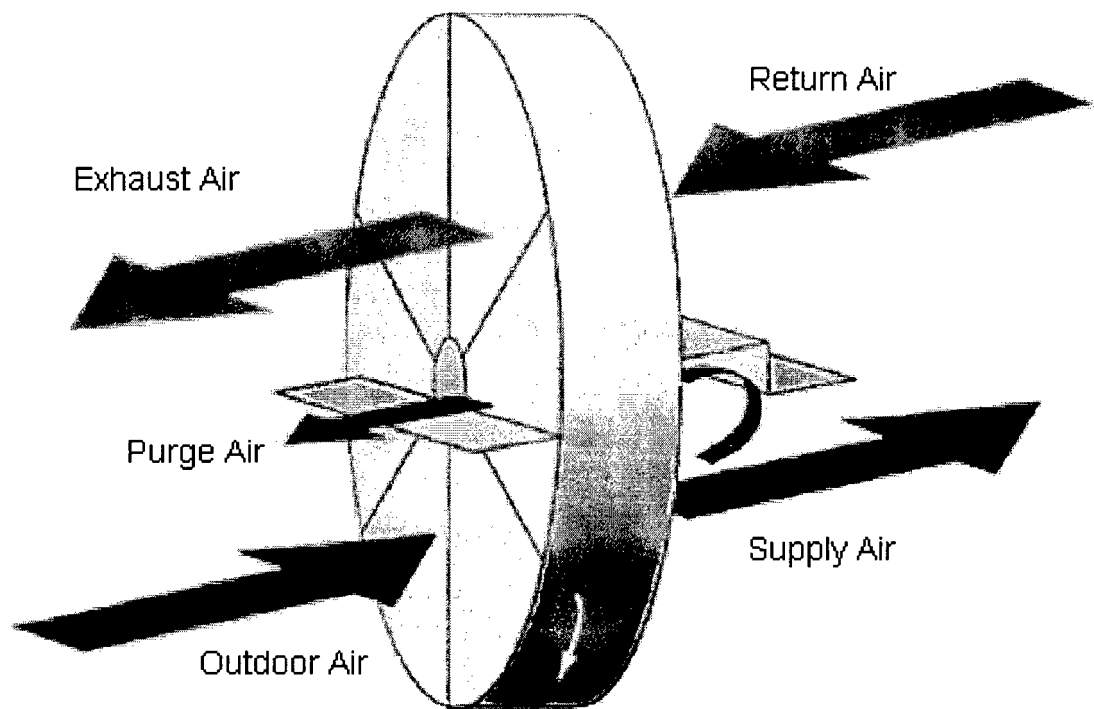


FIG. 1

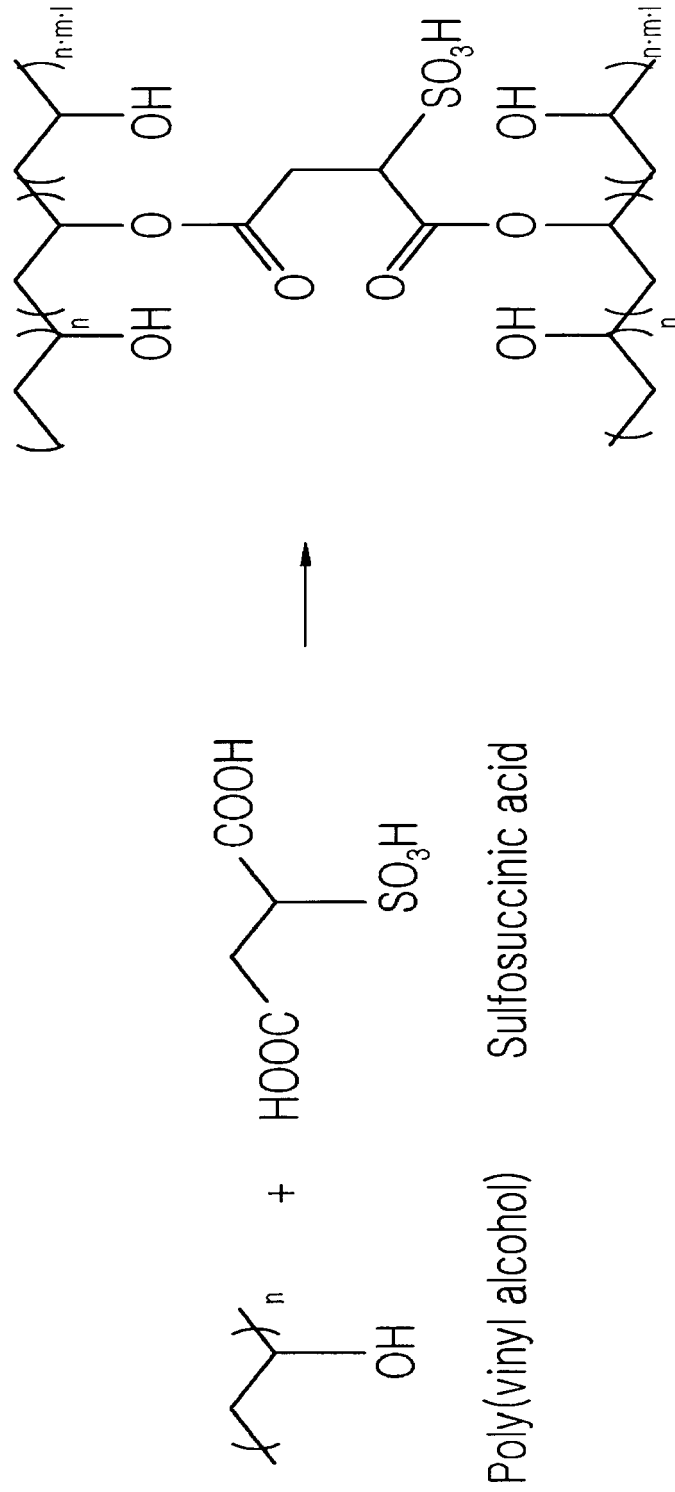


FIG. 2

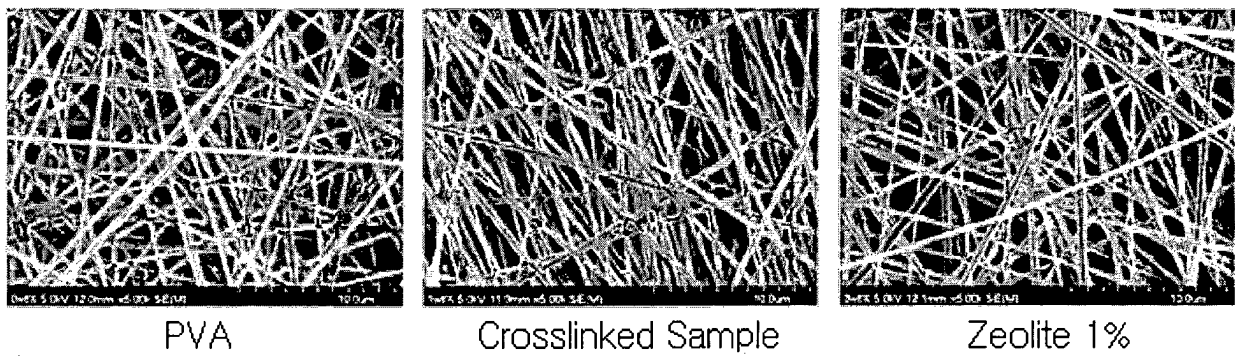


FIG. 3

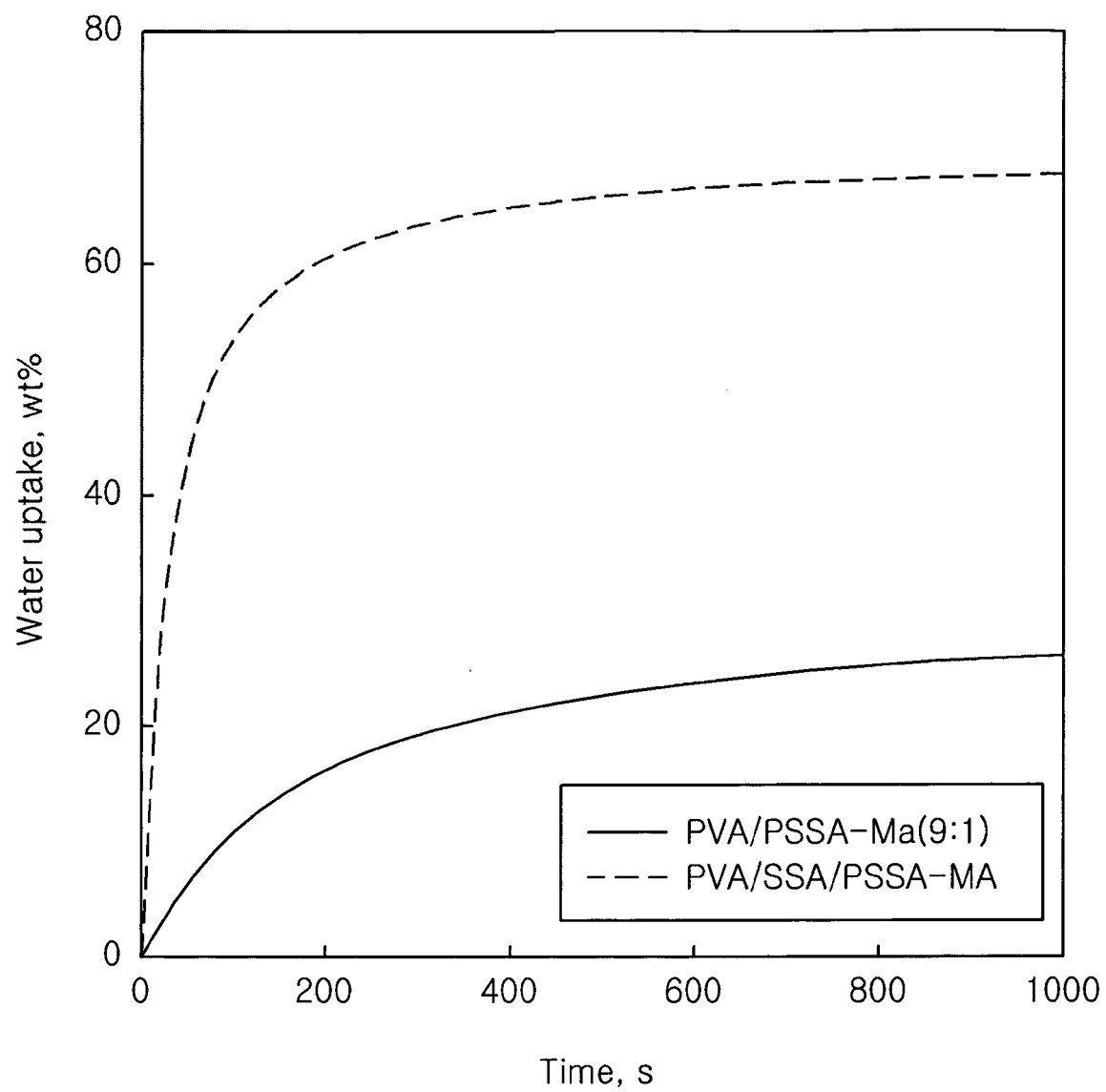


FIG. 4

Crosslinked samples	Initial polymer (g)	After washing (g)	%
1	0.0415	0.0323	77.8
2	0.0403	0.0314	77.9
3	0.0391	0.0298	76.2
Uncrosslinked samples			
1	0.009	0.0003	3.3
2	0.0105	0.0006	5.7
3	0.0177	0.0008	4.5

FIG. 5

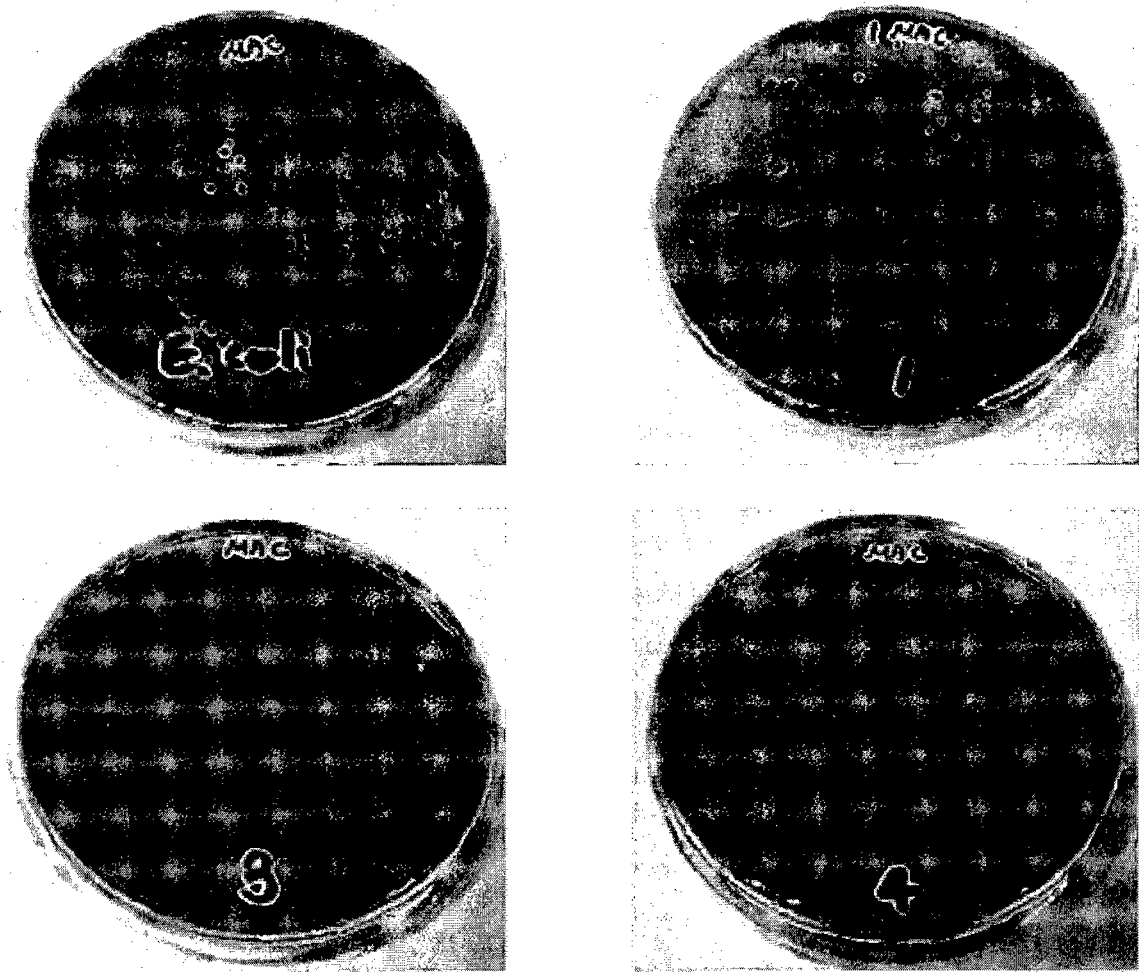


FIG. 6

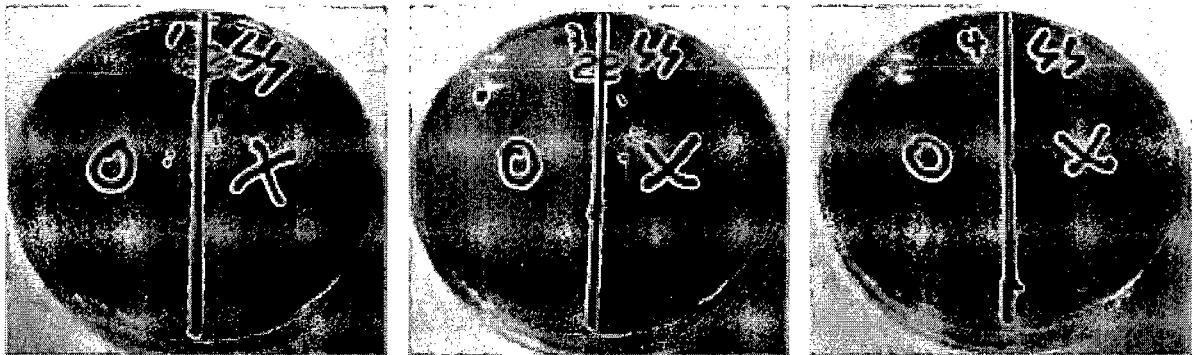


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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