

ANTIMICROBIAL DEODORIZING WORMWOOD INSOLE, PREPARATION METHOD THEREFOR AND APPLICATION THEREOF

TECHNICAL FIELD

5 The present application belongs to the technical field of insoles, for example, an antimicrobial deodorizing wormwood insole, a preparation method therefor and an application thereof.

BACKGROUND

10 Insole is an important part of shoes. Because the insole has direct contact with human body during use, the importance of the insole lies in its direct impact on the comfort of the shoe; at the same time, with the continuous improvement of living standards, the insole is not only required to be comfortable, but also required to have other functions, such as air permeability, sweat-absorption, deodorization, mold resistance, or massage function.

15 At present, most of the insoles provided in the related art are made of cotton or polymer materials. Among them, the cotton insole is still the most commonly used type of insoles currently, and the main advantages of the cotton insole are excellent sweat-absorption capability, as well as being skin-friendly and soft; but as is well known, cotton has strong water absorption, but poor antimicrobial activity and poor abrasion resistance. The polyurethane foam material is a commonly used insole material in polymer materials currently, and the polyurethane foam insole is also a common choice for high-end insoles with good wearing experience due to the advantages of high resilience and wearing durability. In addition, the polyurethane foam insole 20 has a relatively mature preparation process and high production efficiency. Therefore, the innovation of product formulation and production process of the polyurethane foam insole has attracted wide attention.

25 However, the polyurethane foam material itself does not have the functions of sweat-absorption, deodorization, and microbial inhibition, so the following methods are commonly used to improve the antimicrobial activity, deodorizing efficiency, and sweat-removal performance of the polyurethane foam insole. One method is to arrange a surface material on the polyurethane foam insole, and add an antimicrobial powder in the surface material or select an antimicrobial fabric as the surface material. CN109924605A discloses a Chinese herbal medicine insole for the prevention and treatment of tinea pedis, and the insole comprises a surface layer, a middle filling 30 layer, and a rubber bottom layer; the middle filling layer is filled with Chinese herbal medicine

powder; the Chinese herbal medicine powder is prepared from a Chinese medicine composition; the Chinese medicine composition comprises the following components in parts by weight: 18-23 parts by weight of cherokee rose root, 17-24 parts by weight of radix codonopsis , 20-25 parts by weight of radix angelicae sinensis , 12-16 parts by weight of andrographis herb, 17-25 parts by weight of zanthoxylum dissitum hemsl, 16-27 parts by weight of mahoniae caulis, 15-20 parts of suberect spatholobus stem, and 12-17 parts by weight of Philippine flemingia root. The Chinese herbal composition used in the insole is based on the Chinese medicine theory of compatibility, aims at the treatment needs of tinea pedis, fully uses the relationships among traditional Chinese medicine of mutually supporting, mutually restraining and mutually reinforcing, and has the advantages of significant curative efficiency and simple preparation. The insole has remarkable efficiency on the prevention and treatment of tinea pedis, no toxic side effect, significant antimicrobial activity for a variety of foot fungi, and can treat both symptoms and root cause, and thus the disease is not prone to relapse, and the insole is convenient, safe, and comfortable to use and has a promising application prospect. CN112806667A discloses an industrial hemp Chinese herbal medicine foot-care massage health-preserving antimicrobial insole and a preparation method therefor. The insole body comprises a polyurethane layer, the polyurethane layer has high abrasion resistance and lightweight, an upper surface of the polyurethane layer is laminated with an upper linen layer, a lower surface of the polyurethane layer is laminated with a lower linen layer, and the use of linen in the production process enhances the air permeability, antimicrobial activity and water-absorption of the insole; the following raw materials are put into a cavity of the polyurethane layer: 1-3 g of lavender, 2-3 g of rosemary, 1-3 g of mint, 3-4 g of wormwood, 1-2 g of eucalyptus leaves, 1-2 g of pearl powder, 3-4 g of cortex phellodendri, 3-4 g of radix sophorae flavescentis, 3-4 g of cortex pseudolaricis, 2-3 g of basil, and 2-3 g of lemongrass. The above Chinese medicine has the efficiency of tonifying spleen, tranquilization, clearing heat and removing toxin, warming meridians and unblocking collaterals, regulating qi and activating blood, removing toxin and dispersing swelling, so the insole using Chinese medicine plays a role in health preservation for the human body. However, the insole of the above method has the problems of ordinary antimicrobial efficiency and rapid decline of antimicrobial property after repeated wear.

Another method is to directly modify the polyurethane foam material, which comprises adding an organic/inorganic antimicrobial agent into the raw materials of polyurethane to improve the polyurethane material in antimicrobial performance, sweat-absorption, and deodorization. CN113519978A discloses an antimicrobial deodorizing foam insole containing pearl and hemp and a preparation method therefor. The antimicrobial deodorizing foam insole comprises, from

top to bottom, a pearl-hemp foot-contact layer woven by pearl fibers and hemp fibers, a foam layer, and a bottom layer prepared from the polyurethane fabric, and the foam layer is added with attapulgite, pearl powder, and antimicrobial powder. The antimicrobial deodorizing foam insole prepared by this application is soft and skin-friendly, has good moisture-absorption and sweat-absorption, can absorb odor and inhibit the growth of microorganism, which provides a healthy environment for foot. However, the insole prepared by this method has poor comfort and a short antimicrobial period.

Therefore, in view of the above problems, it is urgent to develop a wear-comfortable insole with long-lasting antimicrobial and odor-absorbing functions.

10 SUMMARY

The following is a summary of the subject matter described in detail herein. This summary is not intended to be a limitation to the scope of the claims.

An object of the present application is to provide an antimicrobial deodorizing wormwood insole, a preparation method therefor and an application thereof. Raw materials for preparing the antimicrobial deodorizing wormwood insole comprise polymer polyol, isocyanate, a wormwood powder, activated carbon, a chain extender, and a foaming agent. By employing the activated carbon and wormwood powder as a combination in the raw materials, the obtained antimicrobial deodorizing wormwood insole can have long-lasting antimicrobial and odor-absorbing functions, and is comfortable to wear.

To achieve the object, the present application adopts the following technical solutions.

In a first aspect, examples of the present application provide an antimicrobial deodorizing wormwood insole, and raw materials for preparing the antimicrobial deodorizing wormwood insole comprise the following components:

	polymer polyol	40-60 parts by weight;
25	isocyanate	25-35 parts by weight;
	a wormwood powder	3-7 parts by weight;
	activated carbon	1-3 parts by weight;

a chain extender 2-6 parts by weight; and

a foaming agent 1-3 parts by weight.

5 In the raw materials, the polymer polyol can be 42 parts by weight, 44 parts by weight, 46 parts by weight, 48 parts by weight, 50 parts by weight, 52 parts by weight, 54 parts by weight, 56 parts by weight, or 58 parts by weight, etc.

The isocyanate can be 26 parts by weight, 27 parts by weight, 28 parts by weight, 29 parts by weight, 30 parts by weight, 31 parts by weight, 32 parts by weight, 33 parts by weight, or 34 parts by weight, etc.

10 The wormwood powder can be 3.5 parts by weight, 4 parts by weight, 4.5 parts by weight, 5 parts by weight, 5.5 parts by weight, 6 parts by weight, or 6.5 parts by weight, etc.

The activated carbon can be 1.2 parts by weight, 1.4 parts by weight, 1.6 parts by weight, 1.8 parts by weight, 2 parts by weight, 2.2 parts by weight, 2.4 parts by weight, 2.6 parts by weight, or 2.8 parts by weight, etc.

15 The chain extender can be 2.5 parts by weight, 3 parts by weight, 3.5 parts by weight, 4 parts by weight, 4.5 parts by weight, 5 parts by weight, or 5.5 parts by weight, etc.

The foaming agent can be 1.2 parts by weight, 1.4 parts by weight, 1.6 parts by weight, 1.8 parts by weight, 2 parts by weight, 2.2 parts by weight, 2.4 parts by weight, 2.6 parts by weight, or 2.8 parts by weight, etc.

20 The raw materials for preparing the antimicrobial deodorizing wormwood insole provided by examples of the present application comprise a combination of polymer polyol, isocyanate, a wormwood powder, activated carbon, a chain extender, and a foaming agent in prescribed amounts. By adding the wormwood powder in the raw materials, the resulting insole can obtain a good antimicrobial property, and at the same time, the activated carbon is added by prescribed parts in conjunction with the wormwood powder; in one aspect, the activated carbon can
25 coordinate with the wormwood powder to achieve antimicrobial efficiency, and can also enhance the antimicrobial, sweat-absorbing, and odor-absorbing functions of the insole simultaneously; in another aspect, the adsorption capacity of the activated carbon is utilized to tightly adsorb the wormwood powder, avoiding the problem that wormwood powder is easy to dissipate during the use process of the insole, thus realizing the long-lasting antimicrobial and deodorizing efficiency

of the insole; meanwhile, the insole provided in examples of the present application also has the advantages of abrasion resistance, skid resistance, and high wearing comfort.

In one example, the polymer polyol comprises polyether polyol and polyester polyol.

5 In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the polyether polyol is 20-30 parts by weight, such as 21 parts by weight, 22 parts by weight, 23 parts by weight, 24 parts by weight, 25 parts by weight, 26 parts by weight, 27 parts by weight, 28 parts by weight, or 29 parts by weight, etc.

10 In one example, the polyether polyol comprises any one or a combination of at least two of polytetrahydrofuran-polyether diol, polypropylene oxide-polyether diol, polypropylene oxide-polyether triol, polypropylene oxide/ethylene oxide-polyether diol, or polyethylene glycol monomethyl ether.

15 In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the polyester polyol is 20-30 parts by weight, such as 21 parts by weight, 22 parts by weight, 23 parts by weight, 24 parts by weight, 25 parts by weight, 26 parts by weight, 27 parts by weight, 28 parts by weight, or 29 parts by weight, etc.

In one example, the polyester polyol comprises any one or a combination of at least two of polycarbonate diol, polycaprolactone diol, poly(neopentylene adipate) diol, poly(hexamethylene adipate) diol, or poly(butylene adipate) diol.

20 In one example, a mass ratio of the activated carbon to the wormwood powder is 1:(2-4), such as 1:2.2, 1:2.4, 1:2.6, 1:2.8, 1:3, 1:3.2, 1:3.4, 1:3.6, or 1:3.8, etc.

25 As an optional technical solution for examples of the present application, the mass ratio of the activated carbon to the wormwood powder is limited at 1:(2-4), so that the synergy of the activated carbon and wormwood powder can be optimized, ensuring that the obtained insole has the most excellent antimicrobial and odor-absorbing efficiency, and the efficiency is sustained for the longest period.

In one example, the isocyanate comprises any one or a combination of at least two of 1,6-hexamethylene diisocyanate, isophorone diisocyanate, 4,4-diphenylmethane diisocyanate, hexamethylene diisocyanate, dicyclohexylmethane diisocyanate, tetramethyl-phenylenedimethylene diisocyanate, or toluene diisocyanate, and further optionally,

the isocyanate comprises any one or a combination of at least two of isophorone diisocyanate, dicyclohexylmethane diisocyanate, toluene diisocyanate, hexamethylene diisocyanate, or 4,4-diphenylmethane diisocyanate.

5 In one example, the chain extender comprises a combination of ethylene glycol and diethanolamine.

In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the ethylene glycol is 3-5 parts by weight, such as 3.2 parts by weight, 3.4 parts by weight, 3.6 parts by weight, 3.8 parts by weight, 4 parts by weight, 4.2 parts by weight, 4.4 parts by weight, 4.6 parts by weight, or 4.8 parts by weight, etc.

10 In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the diethanolamine is 1-2 parts by weight, such as 1.1 parts by weight, 1.2 parts by weight, 1.3 parts by weight, 1.4 parts by weight, 1.5 parts by weight, 1.6 parts by weight, 1.7 parts by weight, 1.8 parts by weight, or 1.9 parts by weight, etc.

In one example, the foaming agent comprises water.

15 In one example, graphene is also added in the antimicrobial deodorizing wormwood insole.

As an optional technical solution for examples of the present application, graphene is also added in the antimicrobial deodorizing wormwood insole. The graphene has a loose worm-like structure and excellent deodorizing and antimicrobial properties. The deodorizing and antimicrobial properties of the insole can be further improved due to the addition of a certain amount of graphene as a raw material to be combined with the wormwood powder and the activated carbon.

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In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the graphene is 1-2 parts by weight, such as 1.1 parts by weight, 1.2 parts by weight, 1.3 parts by weight, 1.4 parts by weight, 1.5 parts by weight, 1.6 parts by weight, 1.7 parts by weight, 1.8 parts by weight, or 1.9 parts by weight, etc.

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In one example, the raw materials for preparing the antimicrobial deodorizing wormwood insole further comprise any one or a combination of at least two of a catalyst, silicone oil, a colorant, or water.

In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the catalyst is 0.005-0.04 parts by weight.

In one example, the catalyst comprises any one or a combination of at least two of triethylenediamine, stannous octanoate, dibutyltin dilaurate, or triethylamine.

- 5 In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the silicone oil is 0.5-1.5 parts by weight, such as 0.6 parts by weight, 0.7 parts by weight, 0.8 parts by weight, 0.9 parts by weight, 1 part by weight, 1.1 parts by weight, 1.2 parts by weight, 1.3 parts by weight, or 1.4 parts by weight, etc.

- 10 In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the colorant is 0.5-1.5 parts by weight, such as 0.6 parts by weight, 0.7 parts by weight, 0.8 parts by weight, 0.9 parts by weight, 1 part by weight, 1.1 parts by weight, 1.2 parts by weight, 1.3 parts by weight, or 1.4 parts by weight, etc.

- 15 In one example, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the water is 0.5-1.5 parts by weight, such as 0.6 parts by weight, 0.7 parts by weight, 0.8 parts by weight, 0.9 parts by weight, 1 part by weight, 1.1 parts by weight, 1.2 parts by weight, 1.3 parts by weight, or 1.4 parts by weight, etc.

- 20 In a second aspect, examples of the present application provide a preparation method for the antimicrobial deodorizing wormwood insole according to the first aspect, and the preparation method comprises: mixing polymer polyol, a wormwood powder, activated carbon, a chain extender, a foaming agent, optional graphene, an optional catalyst, an optional colorant, and optional silicone oil with water, performing reaction with isocyanate added, and performing foaming and molding to obtain the antimicrobial deodorizing wormwood insole.

In one example, the mixing is performed at a temperature of 70-90 °C, such as 72 °C, 74 °C, 76 °C, 78 °C, 80 °C, 82 °C, 84 °C, 86 °C, or 88 °C, etc.

- 25 In one example, the mixing is performed for a period of 1-30 min, such as 2 min, 4 min, 6 min, 8 min, 10 min, 12 min, 14 min, 16 min, 18 min, 20 min, 22 min, 24 min, 26 min, or 28 min, etc.

In one example, the reaction is performed at a temperature of 90-110 °C, such as 92 °C, 94 °C, 96 °C, 98 °C, 100 °C, 102 °C, 104 °C, 106 °C, or 108 °C, etc.

In one example, the reaction is performed for a period of 1-2 h, such as 1.1 h, 1.2 h, 1.3 h, 1.4 h, 1.5 h, 1.6 h, 1.7 h, 1.8 h, or 1.9 h, etc.

In one example, the foaming and molding is performed at a temperature of 60-100 °C, such as 65 °C, 70 °C, 75 °C, 80 °C, 85 °C, 90 °C, 95 °C, or 100 °C, etc.

- 5 In a third aspect, examples of the present application provide an application of the antimicrobial deodorizing wormwood insole according to the first aspect in footwear.

In one example, the footwear comprises an athletic shoe.

Compared with the related art, the present application has the following beneficial effects.

- 10 (1) The raw materials for preparing the antimicrobial deodorizing wormwood insole provided by the examples of the present application comprise a combination of polymer polyol, isocyanate, a wormwood powder, activated carbon, a chain extender, and a foaming agent in prescribed amounts; by employing the wormwood powder in the raw materials, the resulting insole can obtain a good antimicrobial property, and at the same time, the activated carbon is added by prescribed parts in conjunction with the wormwood powder, and the activated carbon can
15 coordinate with the wormwood powder to achieve antimicrobial efficiency, and can also adsorb the wormwood powder, thus avoiding the problem that wormwood powder is easy to dissipate during the use process of the insole, which is conducive to the long-term effective release of the wormwood powder, further realizing the long-term antimicrobial and deodorizing efficiency of the insole; meanwhile, the insole provided in the examples of the present application also has the
20 advantages of abrasion resistance, skid resistance, and high wearing comfort.

(2) In the present application, a specific part of graphene is further added in the raw materials, and the graphene has a loose worm-like structure and excellent odor-absorbing and antimicrobial properties. The graphene can be combined with the wormwood powder and activated carbon to further improve the absorption and antimicrobial properties of the insole.

- 25 (3) Specifically, for the antimicrobial deodorizing wormwood insoles provided in the present application, the deodorizing test shows that an absorption rate for ammonia gas can reach 98.1-99.9%, the water absorption test shows that a water absorption rate is 325-350 mg/cm², the antimicrobial test shows that an inhibition rate against *Staphylococcus aureus* is 98.8-99.99%, an inhibition rate against *Klebsiella pneumoniae* is 97.9-99.9%, and an inhibition rate against

Candida albicans is 97.1-99.9%; moreover, after the insole is placed for 1 month, the antimicrobial test is performed for a second time, which shows that the antimicrobial rate for *Staphylococcus aureus* is still as high as 98.1-99.1%, the antimicrobial rate for *Klebsiella pneumoniae* is 97.1-98.9%, and the antimicrobial rate for *Candida albicans* is 97.1-98.4%.

5 DETAILED DESCRIPTION

The technical solution of the present application will be further described hereinafter through the embodiments below. Those skilled in the field should understand that the examples merely assist in understanding the present application but are not to be construed to limit the scope of the present application.

- 10 Raw materials and sources thereof involved in embodiments, including information on manufacturers and grade, are shown in Table 1 below.

Table 1

	Manufacturer	Grade
Polyether polyol	Shenzhen Yiningmeike Science and Technology Co., Ltd	Functionality: 2.6-2.9
Polyester polyol	Yantai Huada Chemical Industry Co., Ltd	CMA-244
Silicone oil	Shandong Juneng Chemical Co., Ltd	/
Colorant	EM Chemicals Co., Ltd	/

Example 1

- 15 This example provides an antimicrobial deodorizing wormwood insole, which is prepared by raw materials comprising the following components in parts by weight:

- 25 parts by weight of polytetrahydrofuran-polyether diol, 25 parts by weight of polycarbonate diol, 33 parts by weight of 4,4-diphenylmethane diisocyanate, 5 parts by weight of a wormwood powder, 1.5 parts by weight of activated carbon, 4 parts by weight of ethylene glycol, 1.5 parts by weight of diethanolamine, 2 parts by weight of water, 1 part by weight of a colorant, 1 part by weight of silicone oil, 2 parts by weight of graphene, and 1 part by weight of water.

A preparation method for the antimicrobial deodorizing wormwood insole provided in this example comprises: polyester polyol, polyether polyol, a wormwood powder, activated carbon,

ethylene glycol, diethanolamine, a foaming agent, graphene, a colorant and silicone oil were mixed in water at 80 °C for 20 min, added with 4,4-diphenylmethane diisocyanate and reacted at 100 °C for 60 min, and subjected to foaming and molding at 70 °C to obtain the antimicrobial deodorizing wormwood insole.

5 Example 2

This example provides an antimicrobial deodorizing wormwood insole, which has raw materials comprising the following components in parts by weight:

20 parts by weight of polyether polyol, 20 parts by weight of polyester polyol, 25 parts by weight of 4,4-diphenylmethane diisocyanate, 3 parts by weight of a wormwood powder, 1 part by weight of activated carbon, 3 parts by weight of ethylene glycol, 1 part by weight of diethanolamine, 1 part by weight of water, 0.5 parts by weight of a colorant, 0.5 parts by weight of silicone oil, 1 part by weight of graphene, and 0.5 parts by weight of water.

A preparation method for the antimicrobial deodorizing wormwood insole provided in this example is the same as that of Example 1.

15 Example 3

This example provides an antimicrobial deodorizing wormwood insole, which is prepared by raw materials comprising the following components in parts by weight:

30 parts by weight of polyether polyol, 30 parts by weight of polyester polyol, 35 parts by weight of 4,4-diphenylmethane diisocyanate, 7 parts by weight of a wormwood powder, 3 parts by weight of activated carbon, 5 parts by weight of ethylene glycol, 1 part by weight of diethanolamine, 3 parts by weight of water, 1.5 parts by weight of a colorant, 1.5 parts by weight of silicone oil, 2 parts by weight of graphene, and 1.5 parts by weight of water.

A preparation method for the antimicrobial deodorizing wormwood insole provided in this example is the same as that of Example 1.

25 Example 4

This example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that no graphene was added, an additive amount of the wormwood powder was 6.5

parts by weight, and an additive amount of the activated carbon was 2 parts by weight. Other components, additive amounts, and preparation methods are the same as in Example 1.

Example 5

5 This example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that an additive amount of the wormwood powder was 4 parts by weight, and an additive amount of the activated carbon was 2.5 parts by weight. Other components, additive amounts, and preparation methods are the same as in Example 1.

Example 6

10 This example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that an additive amount of the wormwood powder was 5.5 parts by weight, and an additive amount of the activated carbon was 1 part by weight. Other components, additive amounts, and preparation methods are the same as in Example 1.

Comparative Example 1

15 This comparative example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that the graphene and activated carbon were not added, and an additive amount of the wormwood powder was 8.5 parts by weight. Other components, additive amounts, and preparation methods are the same as in Example 1.

Comparative Example 2

20 This comparative example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that the graphene and wormwood powder were not added, and an additive amount of the activated carbon was 8.5 parts by weight. Other components, additive amounts, and preparation methods are the same as in Example 1.

Comparative Example 3

25 This comparative example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that the wormwood powder and activated carbon were not added, and an additive amount of the graphene was 8.5 parts by weight. Other components, additive amounts, and preparation methods are the same as in Example 1.

Comparative Example 4

This comparative example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that the activated carbon was not added, and an additive amount of the wormwood powder was 6.5 parts by weight. Other components, additive amounts, and preparation methods are the same as in Example 1.

Comparative Example 5

This comparative example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that the wormwood powder was not added, and an additive amount of the activated carbon was 6.5 parts by weight. Other components, additive amounts, and preparation methods are the same as in Example 1.

Comparative Example 6

This comparative example provides an antimicrobial deodorizing wormwood insole, which differs from Example 1 in that the wormwood powder, activated carbon, and graphene were not added. Other components, additive amounts, and preparation methods are the same as in Example 1.

Performance Test

(1) Deodorizing property: the deodorizing property was evaluated according to the reduction rate of ammonia gas as specified in “Japan Textile Evaluation Technology Council Standards”, the detector tube method was adopted, and the specific operations comprised: a 100 cm² sample was put into a sampling bag, then 3 L of ammonia gas was injected to reach the specified initial concentration, and then after 2 h, the concentration of ammonia gas in the sampling bag was detected with a detection tube to calculate the reduction rate of ammonia gas or acetic acid.

(2) Antimicrobial property: the test was performed according to the test methods provided in “QB/T2881-2013”, the tested strains comprised *Staphylococcus aureus* (with a concentration of 5.8×10^5 CFU/mL), *Klebsiella pneumoniae* (with a concentration of 7.2×10^5 CFU/mL), and *Candida albicans* (with a concentration of 9.1×10^5 CFU/mL).

(3) Antimicrobial persistence: the samples were placed outdoors under natural light for one month, and then tested for their antimicrobial property.

(4) Water absorption: the test was performed according to the test methods provided in “GB21148-2020”.

According to the above test methods, the antimicrobial deodorizing wormwood insoles in Examples 1-6 and Comparative Examples 1-6 are tested, and the test results are shown in Table

5 2.

Table 2

	Deodorizing property (%)	Water absorption (mg/cm ²)	Antimicrobial property (%)			Antimicrobial persistence (%)		
			<i>Staphylococcus aureus</i>	<i>Klebsiella pneumoniae</i>	<i>Candida albicans</i>	<i>Staphylococcus aureus</i>	<i>Klebsiella pneumoniae</i>	<i>Candida albicans</i>
Example 1	99.9	350	99.99	99.9	99.9	98.9	98.7	98.4
Example 2	99.9	345	99.99	99.9	99.2	98.9	98.8	97.9
Example 3	99.9	341	99.99	99.8	99.7	99.1	98.9	98.2
Example 4	98.1	340	99.97	98.9	98.6	98.1	97.2	97.9
Example 5	99.7	325	98.9	98.7	97.9	98.1	97.9	97.1
Example 6	99.8	335	98.8	97.9	97.1	98.1	97.1	97.9
Comparative Example 1	75.3	337	84.3	80.1	79.8	70.3	69.1	56.9
Comparative Example 2	98.9	325	78.9	68.9	59.2	58.1	60.3	50.4
Comparative Example 3	60.5	315	89.3	80.1	78.9	80.3	70.3	58.9
Comparative Example 4	63.5	305	98.1	94.7	87.9	89.3	80.3	78.9
Comparative Example 5	70.1	315	90.1	90.1	89.1	60.5	58.9	62.1

Example 5								
Comparative Example 6	70.3	310	88.2	80.1	78.9	60.2	51.9	48.9

It can be seen from the data in Table 2 that the antimicrobial deodorizing wormwood insole provided by the present application has excellent deodorizing efficiency, antimicrobial property, antimicrobial persistence, and water absorbency; specifically, for the antimicrobial deodorizing wormwood insoles provided in Examples 1-6, the deodorizing test shows that the absorption rate for ammonia gas can reach 98.1-99.9%, the water absorption test shows that the water absorption rate is 325-350 mg/cm², the antimicrobial test shows that the inhibition rate against *Staphylococcus aureus* is 98.8-99.99%, the inhibition rate against *Klebsiella pneumoniae* is 97.9-99.9%, and the inhibition rate against *Candida albicans* is 97.1-99.9%; moreover, the antimicrobial test performed on the insole after placed for 1 month shows that the antimicrobial rate for *Staphylococcus aureus* is still as high as 98.1-99.1%, the antimicrobial rate for *Klebsiella pneumoniae* is 97.1-98.9%, and the antimicrobial rate for *Candida albicans* is 97.1-98.4%.

It can be seen from the comparison of Example 1 and Comparative Examples 1-3 that the deodorizing property, antimicrobial property and antimicrobial persistence of the insole obtained by adding wormgrass powder without graphene and activated carbon (Comparative Example 1) are reduced, especially the antimicrobial persistence; the insole obtained by adding activated carbon without graphene and wormwood powder (Comparative Example 2) has good deodorizing property but poor antimicrobial property and antimicrobial persistence; the antimicrobial property and deodorizing property of the insole obtained by adding graphene without wormwood powder and activated carbon (Comparative Example 3) are both poor; the comparison shows that the insole obtained by adding only one of graphene, activated carbon, or wormwood powder cannot have excellent deodorizing property, antimicrobial property, and antimicrobial persistence at the same time.

Then, it can be seen from the comparison of Example 1 and Comparative Examples 4-6 that the insole obtained by only combining wormwood with graphene without activated carbon (Comparative Example 4), the insole obtained by only combining graphene with activated carbon without wormwood powder (Comparative Example 5), or the obtained insole without graphene, activated carbon, and wormwood powder (Comparative Example 6) also do not have

excellent deodorizing property, antimicrobial property and antimicrobial persistence at the same time.

5 The applicant declares that an antimicrobial deodorizing wormwood insole, a preparation method therefor and an application thereof are illustrated by the above examples, but the present application is not limited to the above examples, that is, the present application does not necessarily rely on the above examples to be implemented. Those skilled in the art should understand that any improvement of the present application, the equivalent substitution of each raw material of products, the addition of auxiliary ingredients, and the selection of specific methods in the present application shall fall within the protection scope and disclosure scope of
10 the present application.

What is claimed is:

1. An antimicrobial deodorizing wormwood insole, which is prepared by raw materials comprising the following components:

polymer polyol 40- 60 parts by weight;

5 isocyanate 25-35 parts by weight;

a wormwood powder 3-7 parts by weight;

activated carbon 1-3 parts by weight;

a chain extender 2-6 parts by weight; and

a foaming agent 1-3 parts by weight.

10 2. The antimicrobial deodorizing wormwood insole according to claim 1, wherein the polymer polyol comprises polyether polyol and polyester polyol.

3. The antimicrobial deodorizing wormwood insole according to claim 2, wherein in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the polyether polyol is 20-30 parts by weight.

15 4. The antimicrobial deodorizing wormwood insole according to claim 2 or 3, wherein the polyether polyol comprises any one or a combination of at least two of polytetrahydrofuran-polyether diol, polypropylene oxide-polyether diol, polypropylene oxide-polyether triol, polypropylene oxide/ethylene oxide-polyether diol, or polyethylene glycol monomethyl ether.

20 5. The antimicrobial deodorizing wormwood insole according to any one of claims 2-4, wherein in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the polyester polyol is 20-30 parts by weight.

25 6. The antimicrobial deodorizing wormwood insole according to any one of claims 2-5, wherein the polyester polyol comprises any one or a combination of at least two of polycarbonate diol, poly(1,4-butanediol adipate) diol, polycaprolactone diol, poly(neopentylene adipate) diol, poly(hexylene adipate) diol, or poly(butylene adipate) diol.

7. The antimicrobial deodorizing wormwood insole according to any one of claims 1-6, wherein a mass ratio of the activated carbon to the wormwood powder is 1:(2-4).

8. The antimicrobial deodorizing wormwood insole according to any one of claims 1-7, wherein the isocyanate comprises any one or a combination of at least two of 1,6-hexamethylene diisocyanate, isophorone diisocyanate, 4,4-diphenylmethane diisocyanate, hexamethylene diisocyanate, dicyclohexylmethane diisocyanate, tetramethyl-phenylenedimethylene diisocyanate, or toluene diisocyanate, and further optionally, any one or a combination of at least two of isophorone diisocyanate, dicyclohexylmethane diisocyanate, toluene diisocyanate, hexamethylene diisocyanate, or 4,4-diphenylmethane diisocyanate.

9. The antimicrobial deodorizing wormwood insole according to any one of claims 1-8, wherein the chain extender comprises a combination of ethylene glycol and diethanolamine;

optionally, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the ethylene glycol is 3-5 parts by weight;

optionally, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the diethanolamine is 1-2 parts by weight;

optionally, the foaming agent comprises water.

10. The antimicrobial deodorizing wormwood insole according to any one of claims 1-9, wherein graphene is further added in the antimicrobial deodorizing wormwood insole;

optionally, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the graphene is 1-2 parts by weight.

11. The antimicrobial deodorizing wormwood insole according to any one of claims 1-10, wherein the raw materials for preparing the antimicrobial deodorizing wormwood insole further comprise any one or a combination of at least two of a catalyst, silicone oil, a colorant, or water;

optionally, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the catalyst is 0.005-0.04 parts by weight;

optionally, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the silicone oil is 0.5-1.5 parts by weight;

optionally, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the colorant is 0.5-1.5 parts by weight;

optionally, in the raw materials for preparing the antimicrobial deodorizing wormwood insole, a content of the water is 0.5-1.5 parts by weight.

- 5 12. The antimicrobial deodorizing wormwood insole according to claim 11, wherein the catalyst comprises any one or a combination of at least two of triethylenediamine, stannous octanoate, dibutyltin dilaurate, or triethylamine.

- 10 13. A preparation method for the antimicrobial deodorizing wormwood insole according to any one of claims 1-12, comprising: mixing polymer polyol, a wormwood powder, activated carbon, a chain extender, a foaming agent, optional graphene, an optional catalyst, an optional colorant, and optional silicone oil with water, performing reaction with isocyanate added, and performing foaming and molding to obtain the antimicrobial deodorizing wormwood insole.

14. The preparation method according to claim 13, wherein the mixing is performed at a temperature of 70-90 °C;

- 15 optionally, the mixing is performed for a period of 1-30 min.

15. The preparation method according to claim 13 or 14, wherein the reaction is performed at a temperature of 90-110 °C;

optionally, the reaction is performed for a period of 1-2 h in step (2).

- 20 16. The preparation method according to any one of claims 13-15, wherein the foaming and molding is performed at a temperature of 60-100 °C.

17. An application of the antimicrobial deodorizing wormwood insole according to any one of claims 1-12 in footwear;

optionally, the footwear comprises an athletic shoe.