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(54) # AEROSOL GENERATING SYSTEM USING MULTI-CALORIC COUPLING GIANT CALORIC EFFECT, AND HEATING MEDIUM

(57) An aerosol generating system using a multi-caloric coupling giant caloric effect, and a heating medium. The heating medium comprises a first heating medium (0113, 0213), which is suitable for an alternating electromagnetic field response frequency in a range of 0.3 to 300 MHz, and a second heating medium (0313), which is suitable for an alternating electromagnetic field response frequency in a range of 0.3 to 30 GHz. A heating medium, which is obtained by means of performing mesoscale composition on components that are correspondingly used and have a high dielectric loss, a high hysteresis loss and a high conductivity loss, meets a material configuration requirement of multi-field coupling generating a multi-caloric giant caloric effect, and has a strong coupling effect and a high heating efficiency. In an aerosol generating system (01, 02, 03), the heating medium serves as heating particles, which are blended with an aerosol substrate or are doped for restituting tobacco sheets, in an aerosol generating substrate (0112, 0212, 0312); alternatively, the heating medium, as a foil-sheet-shaped film composite heating medium (0114, 0214, 0314), serves as an auxiliary enhanced heating medium in an aerosol generating stage; and the heating medium also serves as a block heating medium (0235, 0332) of a heating cavity and a particle coating heating medium (0123, 0223, 0323) of a preheating housing, thereby realizing a multi-source cooperative enhanced heating effect.

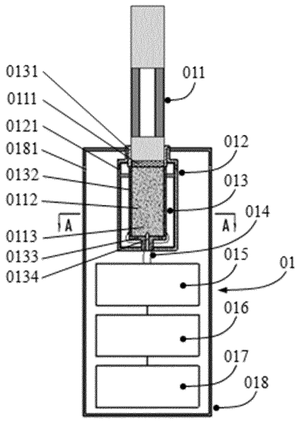

FIG. 1

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Description

[0001] This application claims priority to Chinese Patent Application No. 202210415674.2, titled "AEROSOL GENERATING SYSTEM USING MULTI-CALORIC COUPLING GIANT CALORIC EFFECT, AND HEATING MEDIUM", filed on April 20, 2022 with the China National Intellectual Property Administration, which is incorporated herein by reference in its entirety.

FIELD

[0002] The present disclosure relates to the technical field of tobacco, and in particular to an aerosol generating system using multi-caloric coupling giant caloric effect, and heating medium.

BACKGROUND

[0003] In heat-not-burn cigarettes, an aerosol generating system and method for inhalation by the user are formed by electrically heating an aerosol generating substrate. The most common method is to use the Joule heat generated by the current passing through the resistance heating element to heat the aerosol generating substrate. This type of method has formed a large number of patents and many products and has become well-known in the field. The possible disadvantage of the resistance heating method is difficult to achieve uniform heating of the aerosol generating substrate and accurate control of the heating temperature.

[0004] The electromagnetic induction heating system and method proposed later, of which the series of Chinese patents applied for by Philip Morris Production Company are more typical, include application publication numbers: CN112739228A (Heating assembly and method for inductively heating an aerosol-forming substrate, 2021-04-30); CN110461176A (Susceptor assembly for inductively heating an aerosol-forming substrate, 2019-11-15); CN112739227A (Inductively heatable aerosol-generating article comprising an aerosol-forming substrate and a susceptor assembly, 2021-04-30); CN111449293A, CN111109662A, CN111035072A (Aerosol-forming article comprising magnetic particles, 2020-07-28, 2020-05-08, 2020-04-21); CN112822950A (Susceptor assembly for inductively heating an aerosol-forming substrate, 2021-05-18); CN112739229A (Induction heating assembly for inductively heating an aerosol-forming substrate, 2021-04-30); CN112088577A (Susceptor assembly for aerosol generation comprising a susceptor tube, 2020-12-15); CN112739226A (Inductively heated aerosol-generating device comprising a susceptor assembly, 2021-04-30); CN112384090A (Inductively heatable cartridge for aerosol-generating system and aerosol-generating system comprising an inductively heatable cartridge, 2021-02-19); CN112189901A (Aerosol-generating article with internal susceptor, 2021-01-08); CN112638186A (Inductively heatable aerosol-generating article comprising an aerosol-forming rod segment and method for manufacturing such an aerosol-forming rod segment, 2021-04-09); CN112804899A (Aerosol-generating device for inductively heating an aerosol-forming substrate, 2021-05-14); CN113597263A (Inductively heatable aerosol-forming rod and forming device for producing such a rod, 2021-11-02); CN110731125A (Induction heating device, aerosol-generating system comprising an induction heating device and method of operating the same, 2020-01-24); CN112218554A (Electrical heating assembly for heating an aerosol-forming substrate, 2021-01-12); CN110891441A (Aerosol-generating device with susceptor layer, 2020-03-17); CN112931957A (Susceptor for aerosol-generating device, aerosol-generating device, 2021-06-11); CN110891443A (Aerosol-generating system with multiple susceptors, 2020-03-17); CN110996696A (Aerosol-generating device with induction heater and movable component, 2020-04-10); CN111050582A (Heater for an aerosol-generating device with a connector, 2020-04-21); CN110913712A (Aerosol-generating device with reduced spacing of inductor coils, 2020-03-24); CN111109658A (Electrically heated aerosol-generating system, 2020-05-08); CN111031819A (Aerosol-generating device with removable susceptor, 2020-04-17); CN109475194A (Susceptor assembly and aerosol including the susceptor assembly generate product, 2019-03-15), or the like.

[0005] In the disclosed patents or patent applications related to electromagnetic heating systems and methods, there is no aerosol generating system using multi-caloric coupling giant caloric effect.

SUMMARY

[0006] In view of this, the purpose of the present application is to provide an aerosol generating system using the multi-caloric coupling giant caloric effect and heating medium. In terms of design of heating medium components, the system enhances dielectric loss, hysteresis loss, damping loss, resonance loss and electrical conductance loss. In terms of material structure, the system can realize multi-field coupling to produce multi-caloric coupling giant caloric effect. In terms of pore structure, the system can increase the liquid phase saturated vapor pressure value and reduce the thermal excitation temperature of the aerosol generating substrate. The alternating electromagnetic field can meet the multi-field coupling drive matching requirements, be compatible with and balance the multi-caloric coupling response frequency, and achieve the purpose of uniform heating temperature and low power consumption.

[0007] The present application provides an aerosol generating substrate, comprising a heating medium, where the heating medium comprises a first heating medium or a second heating medium;

[0008] The first heating medium comprises a first dielectric medium, a first magnetic medium and a first conductive medium;

[0009] The first dielectric medium is selected from at least one of following systems:

(1) Perovskite structure system, including $BaTiO_3$, and/or $PbTiO_3$, and/or $NaNbO_3$, and/or $KNbO_3$, and/or BiFeOs; (2) Tungsten bronze structure system, including lead metaniobate, and/or $Sr_{1-x}Ba_xNb_2O_6$; (3) Bismuth layered structure system, including $SrBi_2Ta_2O_9$, and/or $Bi_4Ti_3O_{12}$, and/or $SrBi_4Ti_4O_{15}$; (4) Pyrochlore structure system, including $Cd_2Nb_2O_7$, and/or $Pb_2Nb_2O_7$;

The first magnetic medium is selected from at least one of following ferrites:

Spinel ferrites, including MFe_2O_4, M = Mn, and/or Fe, and/or Ni, and/or Co, and/or Cu, and/or Mg, and/or Zn, and/or Li, and/or MnZn, and/or NiZn, and/or MgZn, and/or LiZn ferrite; and/or $R_3Fe_5O_{12}$, R is a rare earth element, and the rare earth element is Y, and/or La, and/or Pr, and/or Nd, and/or Sm, and/or Eu, and/or Gd, and/or Tb, and/or Dy, and/or Ho, and/or Er, and/or Tm, and/or Yb, and/or Lu;

The first conductive medium is selected from at least one of following components:

ZnO series, including those doped with Al (AZO), and/or doped with In (IZO), and/or doped with Ga (GZO); magnetic oxides, including CoO, and/or MnO, and/or Fe_3O_4, and/or NiO; and other semiconductor oxides, including Ga_2O_3, and/or In_2O_3, and/or InSnO (ITO);

The second heating medium includes a second dielectric medium, a second magnetic medium and a second conductive medium;

The second dielectric medium is selected from (1) $BaO-MgO-Ta_2O_5$, and/or $BaO-ZnO-Ta_2O_5$, and/or $BaO-MgO-Nb_2O_5$, and/or $BaO-ZnO-Nb_2O_5$ systems and composite systems thereof; (2) $BaTi_4O_9$, and/or $Ba-Ti_9O_{20}$, (Zr, and/or Sn)TiO_4-based systems; (3) $BaO-Ln_2O_3-TiO_2$, and/or $CaO-Li_2O-Ln_2O_3-TiO_2$ (in which Ln_2O_3 is a lanthanide rare earth oxide) based system; (4) $A_5B_4O_{15}$ (A=Ba, and/or Sr, and/or Mg, and/or Zn, and/or Ca, B=Nb, and/or Ta), and/or AB_2O_6 (A=Ca, and/or Co, and/or Mn, and/or Ni, and/or Zn; B=Nb, and/or Ta); $(Ba_{1-x}M_x)ZnO_5$ (M=Ca, and/or Sr, x=0 to 1.0), $AgNb_{1-x}Ta_xO_3$ (x=0 to 1.0), and/or $LnAlO_3$ (Ln=La, and/or Nd, and/or Sm), and/or $Ta_2O_5-ZrO_2$, and/or $ZnTiO_3$, and/or $BiNbO_4$ series;

The second magnetic medium is selected from M-type hexagonal ferrite: BaM, and/or PbM, and/or SrM; X-type hexagonal ferrite, including Fe_2X; W-type hexagonal ferrite, including Mg_2W, and/or Mn_2W, and/or Fe_2W, and/or Co_2W, and/or Ni_2W, and/or Cu_2W, and/or Zn_2W; Y-type hexagonal ferrite, including Mg_2Y, and/or Mn_2Y, and/or Fe_2Y, and/or Co_2Y, and/or Ni_2Y, and/or Cu_2Y, and/or Zn_2Y; Z-type hexagonal ferrite, including Mg_2Z, and/or Mn_2Z, and/or Fe_2Z, and/or Co_2Z, and/or Ni_2Z, and/or Cu_2Z, and/or Zn_2Z;

The second conductive medium is selected from ZnO series, including those doped with Al (AZO), and/or doped with In (IZO), and/or doped with Ga (GZO); magnetic oxides including CoO, and/or MnO, and/or Fe_3O_4, and/or NiO; and other semiconductor oxides including Ga_2O_3, and/or In_2O_3, and/or InSnO (ITO).

In an embodiment, the first heating medium is formed into a core-shell type, a heterojunction type, a coating type, a porous type or a film composite type through mesoscopic-scale compounding by physical and chemical methods;

The first heating medium of the core-shell type comprises an electric moment-magnetic moment coupling heating medium 1-H-1 of a core-shell structure, an electric moment-electrical conductance coupling heating medium 1-H-2 of a core-shell structure or an electric moment-magnetic moment-electrical conductance coupling heating medium 1-H-3 of a core-shell structure;

A specific method for forming the first heating medium of the core-shell type is a direct precipitation method, a co-precipitation method, an alcohol salt hydrolysis method, or a sol-gel method;

The first heating medium of the heterojunction structure comprises an electric moment-magnetic moment coupling heating medium 1-Y-1 of a heterojunction structure, an electric moment-electrical conductance coupling heating medium 1-Y-2 of a heterojunction type structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 1-Y-3 of a heterojunction structure;

A specific method of forming the first heating medium of the heterojunction structure is a molten salt method, or a high-heat solid-phase reaction method, or a mechanical alloying method, and a precipitation method with controlled calcination temperature, or an alcohol salt hydrolysis method, or a hydrothermal method, or a sol (gel)-hydrothermal method;

The first heating medium of the coating structure comprises an electric moment-magnetic moment coupling heating medium 1-B-1 of the coating structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 1-B-2 of the coating structure;

A specific method of forming the first heating medium of the coating structure is a mechanical fusion coating method, or a mechanochemical effect method induced by a high-energy mill, or a low-heat solid-phase reaction method, or a sol-gel method;

The first heating medium of a porous structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of a porous structure, or a heating medium 1-D of a low excitation temperature aerosol generating substrate;

The first heating medium of the film composite structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 1- M;

The second heating medium is formed into a core-shell type, or a heterojunction type, or a coating type, or a porous type or a film composite type through mesoscopic-scale compounding by physical and chemical methods;

The second heating medium of the core-shell type includes an electric moment-magnetic moment coupling heating medium 2-H-1 of the core-shell structure, an electric moment-electrical conductance coupling heating medium 2-H-2 of the core-shell structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 2-H-3 of the core-shell structure;

A specific method for forming the second heating medium with the core-shell type is a direct precipitation method, or a co-precipitation method, or an alcohol salt hydrolysis method, or a sol-gel method;

The second heating medium of the heterojunction structure comprises an electric moment-magnetic moment coupling heating medium 2-Y-1 of the heterojunction structure, an electric moment-electrical conductance coupling heating medium 2-Y-2 of the heterojunction structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 2-Y-3 of the heterojunction structure;

A specific method of forming the second heating medium of the heterojunction structure is a molten salt method, or a high-heat solid-phase reaction method, or a mechanical alloying method, and a precipitation method with controlled calcination temperature, or an alcohol salt hydrolysis method, or a hydrothermal method, or a sol (gel)-hydrothermal method;

The second heating medium of the coating structure comprises an electric moment-magnetic moment coupling heating medium 2-B-1 of the coating structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 2-B-2 of the coating structure;

A specific method of forming the second heating medium of the coating structure is a mechanical fusion coating method, or a mechanochemical effect method induced by a high-energy mill, or a low-heat solid-phase reaction method, or a sol-gel method;

The second heating medium of a porous structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of a porous structure, or a heating medium 2-D of a low excitation temperature aerosol generating substrate;

[0010] The second heating medium of the film composite structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 2-M.

[0011] In an embodiment, the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure is prepared according to a following method:

fully mixing ultrafine particles of at least one component of the first dielectric medium, the first magnetic medium and the first conductive medium in the first heating medium with the inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and the pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure; or performing a polymer network gel method on at least one component in the first dielectric medium, at least one component in the first magnetic medium system and at least one component in the first conductive medium to obtain a gel, or performing a metal complex gel method to obtain a soluble complex network gel, and then drying, sintering, crushing and classifying to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure; or modifying the first dielectric medium particle porous body by precipitation method using ions of at least one component of the first magnetic medium and ions of at least one component of the first conductive medium in the solution and a precipitant, so that a composite film layer of the first magnetic medium component and the first conductive medium component is formed on the inner surface of the pores, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure; or fully mixing ultrafine particles of at least one component of the first dielectric medium and the first magnetic medium in the first heating medium with an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and a pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying to obtain the electric moment-magnetic moment coupling heating medium of the porous structure, modifying pores of the electric moment-magnetic moment coupling heating medium of the porous structure by chemical plating method, and the metal ions of at least one component of the first conductive medium system adsorbed in the plating solution in the pores being catalytically reduced to metal by the reducing agent in the plating solution and deposited on the inner surface of the pores to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure;

The electric moment-magnetic moment-electrical conductance coupling heating medium of the porous structure has a pore size of 2nm to 50μm, and a porosity of 70% to 95%.

[0012] The electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure is prepared according to a following method:

fully mixing ultrafine particles of at least one component of the second dielectric medium, the second magnetic medium and the second conductive medium in the second heating medium with the inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and the pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure; or performing a polymer network gel method on at least one component in the second dielectric medium, at least one component in the second magnetic medium system and at least one component in the second conductive medium to obtain a gel, or performing a metal complex gel method to obtain a soluble complex network gel, and then drying, sintering, crushing and classifying to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure; or modifying the second dielectric medium particle porous body by precipitation method using ions of at least one component of the second magnetic medium system and ions of at least one component of the second conductive medium system in the solution and a precipitant, so that a composite film layer of the second magnetic medium component and the second conductive medium component is formed on the inner surface of the pores, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure; or fully mixing ultrafine particles of at least one component of the second dielectric medium and the second magnetic medium in the second heating medium with an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and a pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying to obtain the electric moment-magnetic moment coupling heating medium of the porous structure, modifying pores of the electric moment-magnetic moment coupling heating medium of the porous structure by chemical plating method, and the metal ions of at least one component of the second conductive medium adsorbed in the plating solution in the pores being catalytically reduced to metal by the reducing agent in the plating solution and deposited on the inner surface of the pores to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure, wherein the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure has a pore size of 2nm to 50μm and a porosity of 70% to 95%.

[0013] In an embodiment, the heating medium 1-D of the low excitation temperature aerosol generating substrate is prepared according to a following method:

from the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure, selecting particles with a pore size ranging from 60nm to 50μm, a porosity ranging from 85% to 95%, a specific heat capacity ranging from 0.1 $kJ \cdot kg^{-1} \cdot K^{-1}$ to 0.6 $kJ \cdot kg^{-1} K^{-1}$, and a coefficient of thermal conductivity ranging from 0.035 $W \cdot m^{-1} \cdot K^{-1}$ to 0.125 $W \cdot m^{-1} \cdot K^{-1}$ to adsorb the liquid phase components of the aerosol generating medium, so that the liquid phase components are separated into small droplets entering the pores with a porosity of 85% to 95% and a pore size ranging from 60nm to 50μm, to increase the saturated vapor pressure value of the liquid phase component of the aerosol generating medium, and obtain the heating medium of the low excitation temperature aerosol generating substrate, wherein the excitation temperature is 160°C to 200°C, and the particle size distribution range of the heating medium 1-D of the low excitation temperature aerosol generating substrate is 15μm to 500μm.

[0014] The heating medium 2-D of the low excitation temperature aerosol generating substrate is prepared according to the following method:

from the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure, selecting particles with a pore size ranging from 60nm to 50μm, a porosity ranging from 85% to 95%, a specific heat capacity ranging from 0.1 $kJ \cdot kg^{-1} \cdot K^{-1}$ to 0.6 $kJ \cdot kg^{-1} K^{-1}$, and a coefficient of thermal conductivity ranging from 0.035 $W \cdot m^{-1} \cdot K^{-1}$ to 0.125 $W \cdot m^{-1} \cdot K^{-1}$ to adsorb the liquid phase components of the aerosol generating medium, so that the liquid phase components are separated into small droplets entering the pores with a porosity of 85% to 95% and a pore size ranging from 60nm to 50μm, to increase the saturated vapor pressure value of the liquid phase components of the aerosol generating medium, and obtain the heating medium of the low excitation temperature aerosol generating substrate, wherein the excitation temperature is 160°C to 200°C, and the particle size distribution range of the heating medium 2-D of the low excitation temperature aerosol generating substrate is 15μm to 500μm.

[0015] In an embodiment, the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M is prepared according to the following method:

fully mixing the ultrafine particles of at least one component of the first dielectric medium and the first magnetic medium and the first conductive medium systems in the first heating medium with the binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, performing a single-sided or double-sided film composite on an aluminum sheet, a copper sheet, or a stainless steel sheet by a spraying method or a brushing method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M of the film composite structure; or performing a single-sided or double-sided film composite depositing or spraying on an aluminum sheet, a copper sheet, or a stainless steel sheet by a vapor deposition method, a flame vapor deposition method, or a plasma spraying method using the particles of at least one component of the first dielectric medium and the first magnetic medium and the first conductive medium systems in the first heating medium to prepare the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M of the film composite structure.

[0016] The electric moment-magnetic moment-electrical conductance coupling heating medium 2-M is prepared according to the following method:

fully mixing the ultrafine particles of at least one component in the second dielectric medium, the second magnetic medium and the second conductive medium systems in the second heating medium with the binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, performing a single-sided or double-sided film composite on an aluminum sheet, a copper sheet or a stainless steel sheet by a spraying method or a brushing method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M of the film composite structure; or performing a single-sided or double-sided film composite depositing or spraying on an aluminum sheet, a copper sheet, or a stainless steel sheet by a vapor deposition method, a flame vapor deposition method, or a plasma spraying method using the particles of at least one component of the second dielectric medium and the second magnetic medium and the second conductive medium systems in the second heating medium to prepare the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M of the film composite structure.

[0017] In an embodiment, the aerosol generating substrate further comprises a gas-mist substrate;

> the heating medium is directly blended with the gas-mist substrate, or the heating medium is mixed into the fiber slurry or paste before the tobacco sheet in the gas-mist substrate is manufactured or roller-pressed, so that the tobacco sheet is uniformly distributed with a heating medium of 5% to 60% by mass, and the particle size of the heating medium is 0.1 μm to 100 μm;
>
> or the heating medium of a porous structure of 15 μm to 100 μm or the heating medium of a low excitation temperature aerosol generating substrate with a particle size of 15 μm to 100μm absorbs the liquid phase components in the gas-mist substrate, and then blends with the heating medium and the gas-mist substrate.

[0018] In an embodiment, the aerosol generating substrate further comprises a foil-like film composite heating medium; the foil-like film composite heating medium is prepared by mixing the heating medium particles with the binder carboxymethyl cellulose, or guar gum or tobacco extract, and then performing a single-sided or double-sided film composite on an aluminum foil or copper foil using a casting method or a spraying method, and then cutting to a size equivalent to that of tobacco sheets, the particle size distribution range of the heating medium particles is 15μm to 100μm;

or prepared by using the dielectric medium component and the precursor of the magnetic medium component by a chemical vapor deposition method, or a gas phase pyrolysis method, or a gas phase hydrolysis method, or a gas phase combustion method, or a flame vapor deposition method.

[0019] The present application provides an aerosol generating system using the multi-caloric coupling giant caloric effect, comprising a heating structure, the heating structure comprises a housing, and the housing is provided with a housing air inlet;

a preheating shell is provided inside the housing; the housing and the preheating shell are coaxially opened;

the opening of the preheating shell is connected to the filter section; the preheating shell is provided with a preheating shell air inlet;

a plurality of electrode plates are provided inside the preheating shell; the plurality of electrode plates form a heating chamber;

a heating chamber base is provided at the bottom of the heating chamber; a temperature control unit passes through the central hole of the heating chamber base, and a base disc air inlet is provided on the heating chamber base;

an upper end of the heating chamber is connected to a sealing ring and nested in the opening of the preheating shell;

an interior of the electrode plate is an aerosol generating section; a metal particle layer filter medium is provided between the aerosol generating section and the filter section;

the aerosol generating section contains an aerosol generating substrate 1;

the electrode plate is connected to a heating drive unit through an electrode plate feeder;

the aerosol generating substrate 1 includes the first heating medium.

[0020] In an embodiment, the electrode plate is a tubular electrode plate; the tubular electrode plate comprises a tubular insulating ceramic substrate, and a curved electrode 1 and a curved electrode 2 arranged on the inner surface of the tubular insulating ceramic substrate;
The curved electrode 1 and the curved electrode 2 are arranged in pieces and are opposite to each other; the adjacent curved electrodes 1 and the curved electrodes 2 are separated by insulating materials;
The number of the curved electrodes 1 and the curved electrodes 2 is respectively within the range from 2 to 5.

[0021] In an embodiment, the electrode plate is a plurality of planar electrodes; the electrode plate comprises a planar electrode plate 1 and a planar electrode plate 2 which are parallel and opposite to each other;
The distance between the planar electrode plate 1 and the planar electrode plate 2 is the diameter of the aerosol generating section.

[0022] In an embodiment, a block heating medium 1 is sandwiched between each of two pairs of corresponding ends of the planar electrode plate 1 and the planar electrode plate 2;
A cylindrical hole is arranged at the symmetric center of the two sandwiched block heating media 1, and the diameter of the cylindrical hole is the diameter of the aerosol generating section.

[0023] In an embodiment, the thickness of the metal particle layer filter medium is 0.2mm to 1.2mm;
The metal particle layer filter medium is formed by pressing aluminum particles with a size of 0.5 to 1.5mm.

[0024] In an embodiment, the block heating medium 1 comprises first heating medium particles and an inorganic binder;
The inorganic binder is selected from one or more of sodium silicate, aluminum dihydrogen phosphate and phosphoric acid-copper oxide.

[0025] In an embodiment, the base disc air inlet is a through hole with a diameter of 0.3 to 2mm;
The number of the air inlets is 8 to 36.

[0026] In an embodiment, the frequency of the alternating electromagnetic field used in the heating drive unit has a balanced compatible response frequency that meets the requirements of multi-caloric coupling of electric caloric, magnetic caloric and conductive caloric for multi-field coupling drive. When the compatible response frequency is in a range of 0.3MHz to 300MHz, it is suitable for the first heating medium.

[0027] In an embodiment, the inner surface of the preheating shell is provided with a first heating medium particle coating;

the first heating medium particle coating comprises a hexagonal boron carbon nitrogen ternary wave absorbing ceramic substrate and a coating coated on the substrate. The coating comprises first heating medium particles and a film-forming agent; the film-forming agent is selected from sodium silicate sol, or aluminum dihydrogen phosphate sol, or aluminum hydroxide sol, or silica sol;

or the first heating medium particle coating comprises a metal substrate and a coating coated on the metal substrate, the coating comprises first heating medium particles and an inorganic binder;

the inorganic binder is selected from sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide.

[0028] The present application provides an aerosol generating system using multi-caloric coupling giant caloric effect, comprising a heating structure, where the heating structure includes a housing, and the housing is provided with a housing air inlet;

a preheating shell is provided inside the housing; the housing and the preheating shell are coaxially opened;

the opening of the preheating shell is connected to the filter section; the preheating shell is provided with a preheating shell air inlet;

the interior of the preheating shell is provided with a metal shielding shell, a block heating medium 2 and an antenna embedded in the block heating medium 2; the metal shielding shell is wrapped around the outside of the block heating medium 2;

the metal shielding shell, the block heating medium 2 and the antenna embedded in the block heating medium 2 form a heating chamber;

an air inlet seat hole of the heating chamber communicates with the outside of the block heating medium 2 through 4 to 10 air inlet channels with a diameter of 0.5 to 2mm;

the block heating medium 2 is a cube; a cylindrical hole is arranged at the symmetry axis of the block heating medium 2, and an aerosol generating section is formed inside the hole; a wave-transmitting ceramic tube is nested in the cylindrical hole, and the inner diameter of the wave-transmitting ceramic tube is the diameter of the aerosol generating section;

the upper end of the heating chamber is connected to the sealing ring and nested in the opening of the preheating shell;

a metal particle layer filter medium is provided between the aerosol generating section and the filter section;

the aerosol generating section contains an aerosol generating substrate 2;

the antenna is connected to the heating drive unit through the antenna feeder pin;

the aerosol generating substrate 2 comprises the second heating medium described in claim 1.

[0029] In an embodiment, the wave-transmitting ceramic tube is selected from a quartz SiO_2 ceramic tube, a high alumina ceramic tube, or a Si_3N_4 ceramic tube.

[0030] In an embodiment, the aerosol generating system further comprises a temperature control unit, and the temperature control unit is transversely placed on the inner surface of the wave-transmitting ceramic tube at a position of 2-3 mm away from the free port of the aerosol generating section.

[0031] In an embodiment, the block heating medium 2 comprises second heating medium particles and an inorganic binder;

The inorganic binder is selected from sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide.

[0032] In an embodiment, a second heating medium particle coating is provided on the inner surface of the preheating shell;

the second heating medium particle coating comprises a hexagonal boron carbon nitrogen ternary wave absorbing ceramic substrate and a coating coated on the substrate, and the coating comprises second heating medium particles and a film-forming agent; the film-forming agent is selected from sodium silicate sol, or aluminum dihydrogen phosphate sol, or aluminum hydroxide sol, or silica sol;

or the second heating medium particle coating comprises a metal substrate and a coating coated on the metal substrate, and the coating comprises second heating medium particles and an inorganic binder;

the inorganic binder is selected from sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide.

[0033] In an embodiment, the frequency of the alternating electromagnetic field used by the heating drive unit has a balanced compatible response frequency that meets the requirements of multi-caloric coupling of electric caloric, magnetic caloric and conductive caloric for multi-field coupling driving. When the compatible response frequency is in a range from 0.3GHz to 30GHz, it is suitable for the second heating medium.

[0034] In the aerosol generating system using the multi-caloric coupling giant caloric effect provided according to embodiments of the present application, (1) regarding the dielectric medium component of the heating medium, measures are taken to strengthen the inherent electric moment orientation polarization, the thermal ion relaxation polarization and the ion displacement polarization, so as to optimize the utilization of the relaxation polarization loss and the resonance polarization loss, and obtain a high polarization loss dielectric medium; regarding the magnetic medium component of the heating medium, measures are taken to strengthen the hysteresis loss, the damping loss and the resonance loss, so as to obtain a high hysteresis loss magnetic medium; regarding the conductive medium component of the heating medium, measures are taken to increase the free electrons, ions and the doping defects and vacancies, so as to optimize the utilization of the electrical conductance loss of various carriers, and obtain a conductive medium with high electrical conductance loss; (2) regarding the material structure of the heating medium, the dielectric medium, the magnetic medium and the conductive medium are compositely constructed by a physical and chemical method of multi-phase components to form a core-shell structure, or a heterojunction structure, or a coating structure, or a porous structure or a film composite structure, so as to realize the composite at the mesoscopic scale, so as to facilitate the multi-field coupling to generate the multi-caloric coupling giant caloric effect; (3) regarding lowering the thermal excitation temperature of the aerosol generating substrate, the heating medium of the porous structure adsorbs the liquid phase components of the aerosol generating medium, so that the liquid phase components are differentiated into a large number of small droplets; (4) regarding the heating drive unit of the aerosol generating system, the used frequency of the alternating electromagnetic field is a balanced compatible response frequency that meets the requirements of multi-caloric coupling of electric caloric, magnetic caloric and conductive caloric for multi-field coupling drive, and the compatible response frequency range is 0.3MHz to 30GHz.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

FIG. 1 is an axial exemplary cross-sectional view of the first aerosol generating system form 01 of the aerosol generating system and method using multi-caloric coupling giant caloric effect.

FIG. 2 is an enlarged axial exemplary cross-sectional view of the heating structure A of the aerosol generating system of the first aerosol generating system form 01 of the aerosol generating system and method using multi-caloric coupling giant caloric effect.

FIG. 3 is a top view at the A-A section of FIG. 2.

FIG. 4 is an enlarged axial exemplary cross-sectional view of the heating structure A of the aerosol generating system of the first aerosol generating system form 01 of the aerosol generating system and method using multi-caloric coupling giant caloric effect, where the aerosol generating section contains a foil-like film composite heating medium.

FIG. 5 is a top view at the A-A section of FIG. 4.

FIG. 6 is an exemplary expansion diagram of a curved electrode 1 and a curved electrode 2 of the tubular electrode plate along the circumferential direction in the heating structure A of the aerosol generating system of the first aerosol generating system form 01 of the aerosol generating system and method using multi-caloric coupling giant caloric effect.

FIG. 7 is an axial exemplary cross-sectional view of the second aerosol generating system form 02 of the aerosol generating system and method using multi-caloric coupling giant caloric effect.

FIG. 8 is an enlarged exemplary top view of the C-C section of the heating structure B of the aerosol generating system of the second aerosol generating system form 02 of the aerosol generating system and method using multi-caloric coupling giant caloric effect.

FIG. 9 is an axial exemplary cross-sectional view of the third aerosol generating system form 03 of the aerosol generating system and method using multi-caloric coupling giant caloric effect.

FIG. 10 is an enlarged axial exemplary cross-sectional view of the heating structure C of the aerosol generating system of the third aerosol generating system form 03 of the aerosol generating system and method using multi-caloric coupling giant caloric effect.

FIG. 11 is an enlarged exemplary top view of the B-B section of the heating structure C of the aerosol generating system of the third aerosol generating system form 03 of the aerosol generating system and method using multi-caloric coupling giant caloric effect.

FIG. 12 is a SEM image of the first heating medium of the core-shell structure in Example 1 of the present application.

FIG. 13 is a SEM image of the first heating medium of the heterojunction structure in Example 2 of the present application.

FIG. 14 is a SEM image of the second heating medium of the coating structure in Example 3 of the present application.

FIG. 15 is a SEM image of the second heating medium of the coating structure in Example 4 of the present application.

FIG. 16 is a SEM image of the first heating medium of the porous structure in Example 5 of the present application.

FIG. 17 is a SEM image of the film composite structure coupled heating medium in Example 6 of the present application.

FIG. 18 is a SEM image of the second heating medium of the coating structure in Example 7 of the present application.

FIG. 19 is a SEM image of the second heating medium of the coating structure in Example 8 of the present application.

FIG. 20 is a SEM image of the second heating medium of the coating structure in Example 9 of the present application.

FIG. 21 is a SEM image of the second heating medium of the coating structure in Example 10 of the present application.

DETAILED DESCRIPTION OF EMBODIMENTS

[0036] The multi-caloric coupling giant caloric effect described in the present application is described as follows:

(1) Under the drive of an external alternating electric field and an alternating magnetic field, the heat effect generated by the coupling of the electric dipole formed by polarization and the magnetic dipole formed by magnetization includes not only the electric moment heat effect formed by a single electric moment entropy and the magnetic moment heat effect formed by a single magnetic moment entropy, but also the electric moment and magnetic moment coupling heat effect formed by the electric moment-magnetic moment coupling entropy.
(2) Under the drive of an external alternating electromagnetic field and a component alternating electric field of an alternating electromagnetic field, the heat effect generated by the coupling of the electric dipole formed by polarization and the carrier formed by polarization includes not only the electric moment heat effect formed by a single electric moment entropy and the Joule heat effect formed by a single lattice entropy and electron entropy, but also the electric moment and electrical conductance coupling heat effect formed by the electric moment-(lattice + electron) coupling entropy.
(3) Under the action of the external alternating electromagnetic field and component alternating electric field and alternating magnetic field of the external alternating electromagnetic field, the thermal effect generated by the

coupling of electric dipoles and carriers formed by polarization and magnetic dipoles formed by magnetization includes not only the electric moment thermal effect formed by a single electric moment entropy, the magnetic moment thermal effect formed by a single magnetic moment entropy, and the Joule thermal effect formed by a single lattice entropy and electron entropy, but also the electric moment and magnetic moment coupling thermal effect formed by electric moment-magnetic moment coupling entropy, the electric moment and electrical conductance coupling thermal effect formed by electric moment-(lattice + electron) coupling entropy, the magnetic moment and electrical conductance coupling thermal effect formed by magnetic moment-(lattice + electron) coupling entropy, and the electric moment, magnetic moment and electrical conductance coupling thermal effect formed by electric moment-magnetic moment-(lattice + electron) coupling entropy.

[0037] It should be pointed out that the multi-caloric effect is not simply the sum of various single caloric effects, but also includes multiple related coupling terms formed by the cross-coupling between various single caloric effects, making the heat release phenomenon more significant.

[0038] The following is the temperature change (ΔT) equation of the material system based on the multi-caloric coupling effect, including the multiple related coupling terms formed by the cross-coupling between single caloric effects:

$$\Delta T = -\frac{T}{C}\sum_{i;i\neq j}\int_{x_j}\left[\left(\frac{\partial X_i}{\partial T}\right)_{x_j}\frac{\alpha_{ij}}{\chi_i}+\left(\frac{\partial X_j}{\partial T}\right)_{x_i}\right]dx_j$$

where X_i = M, P, ε,...; x_i = H, E, σ,.... The equation covers all caloric effects, including the electro caloric effect, the magnetic caloric effect, the conductive caloric effect, and the cross-coupled multi-caloric effect.

[0039] For the electric moment-magnetic moment coupling thermal effect, the above equation is specifically expressed in the following form:

$$\Delta T = \Delta T_e + \Delta T_m = -\frac{T}{C}\int_{E_i}^{E_f}\left[\left(\frac{\partial P}{\partial T}\right)_{H,E}+\frac{\alpha_e}{\mu_0\chi^m}\left(\frac{\partial M}{\partial T}\right)_{H,E}\right]dE-\frac{T}{C}\int_{H_i}^{H_f}\left[\left(\frac{\partial M}{\partial T}\right)_{H,E}+\frac{\alpha_m}{\varepsilon_0\chi^e}\left(\frac{\partial P}{\partial T}\right)_{H,E}\right]dH$$

[0040] In the formula, the corresponding terms of the temperature rise ΔT_e of the electro caloric effect and the temperature rise ΔT_m of the magnetic caloric effect, apparently, not only have the temperature rise terms generated by the change of the polarization intensity with the change of the electric field intensity and the temperature rise terms generated by the change of the magnetic field intensity with the change of the magnetic field intensity, but also include the cross-coupling effect temperature rise terms of the change of the electric field intensity related to the dielectric medium and magnetic medium with the change of the magnetic field intensity, and the change of the magnetic field intensity with the change of the polarization intensity. This is also a principle basis for the formation of the multi-caloric coupling giant caloric effect described in the present application.

[0041] In the present application, regarding the dielectric medium component of the heating medium, measures are taken to strengthen the inherent electric moment orientation polarization, hot ion relaxation polarization and ion displacement polarization to optimize the use of relaxation polarization loss and resonance polarization loss to obtain a high polarization loss dielectric medium; regarding the magnetic medium component of the heating medium, measures are taken to strengthen hysteresis loss, damping loss and resonance loss to obtain a high hysteresis loss magnetic medium; regarding the conductive medium component of the heating medium, measures such as increasing free electrons, ions and doping defects and vacancies are taken to optimize the use of electrical conductance losses of multiple carriers to obtain a conductive medium with high electrical conductance loss.

[0042] The present application conducts composite construction of the above-mentioned dielectric medium, magnetic medium and conductive medium by physical and chemical methods of multi-phase components to form a core-shell structure, a heterojunction structure, a coating structure, a porous structure and a film composite structure, and realize the composite at the mesoscopic scale, so as to facilitate the multi-field coupling to produce a multi-caloric giant caloric effect:

(1) Core-shell structure: Ultrafine magnetic medium particles with high hysteresis loss are used as the core and surface-functionalized, and used to modify the dielectric material with high polarization loss through seed growth method, or ultrafine dielectric particles with high polarization loss are used as the core and surface-functionalized, and used to modify the magnetic dielectric material with high hysteresis loss through seed growth method to obtain the electric moment-magnetic moment coupling heating medium of the core-shell structure; ultrafine dielectric particles

with high polarization loss are used as the core and surface-functionalized, and used to modify the conductive dielectric material with high electrical conductance loss through the seed growth method to obtain the electric moment-electrical conductance coupling heating medium of the core-shell structure; ultrafine dielectric particles with high polarization loss are used as the core and surface-functionalized, and used to modify the magnetic dielectric material with high hysteresis loss and the conductive dielectric material with high electrical conductance loss by the seed growth method, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the core-shell structure. The core-shell structure can be prepared by wet chemical methods such as direct precipitation method, co-precipitation method, or alcohol salt hydrolysis method or sol-gel method.

(2) Heterojunction structure: Dielectric particles with high polarization loss and magnetic dielectric particles with high hysteresis loss are uniformly mixed in the phase contact interface region, and due to different crystal structures and low lattice matching, are subjected to epitaxial growth by calcination and melt precipitation to obtain a heterojunction type electric moment-magnetic moment coupling heating medium; similarly, dielectric particles with high polarization loss and conductive dielectric particles with high electrical conductance loss are uniformly mixed in the phase contact interface region, and are subjected to epitaxial growth by calcination and melt precipitation to obtain a heterojunction type electric moment-conductance coupling heating medium; dielectric particles with high polarization loss, magnetic dielectric particles with high hysteresis loss, high damping loss and resonance loss and conductive dielectric particles with high electrical conductance loss are uniformly mixed in the phase contact interface region, and are subjected to epitaxial growth by calcination and melt precipitation to obtain a heterojunction type electric moment-magnetic moment-conductance coupling heating medium. The heterojunction structure can be prepared by molten salt method, high-temperature solid-phase reaction method, mechanical alloying method, precipitation method with controlled calcination temperature, alcohol salt hydrolysis method, hydrothermal method, or sol (gel)-hydrothermal method.

(3) Coating structure: Ultrafine dielectric sub-particles with high polarization loss are coated using magnetic medium with high hysteresis loss as the mother particle, to obtain the electric moment-magnetic moment coupling heating medium of the coating structure; ultrafine dielectric sub-particles with high polarization loss and ultrafine conductive medium sub-particles with high electrical conductance loss are coated using magnetic medium with high hysteresis loss as the mother particle, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the coating structure. The coating structure can be prepared by mechanical method, such as mechanical fusion coating equipment, through mechanical chemical effect caused by mechanical forces such as shearing, friction, extrusion, and impact, to compound dielectric particles with high polarization loss, with magnetic medium particles high hysteresis loss, and with conductive medium particles high electrical conductance loss together. The coating structure can also be prepared by low-heat solid phase reaction method, or sol-gel method.

(4) Porous structure: Magnetic medium particles with high hysteresis loss, dielectric particles with high polarization loss, conductive medium particles with high electrical conductance loss are fully mixed with inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and pore-forming agent, and sintered, and the porous sintered body is appropriately crushed and classified to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the porous structure. In addition, the porous structure can be prepared by polymer network gel method and metal complex gel method. The porous structure can also be prepared by modifying dielectric porous ceramics with high polarization loss by precipitation method using ions of magnetic medium with high hysteresis loss and ions of conductive medium with high electrical conductance loss in the solution by using appropriate precipitants, so that a composite film layer of magnetic medium with high hysteresis loss and conductive medium with high electrical conductance loss is formed on the inner surface of the pores, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the porous structure. The porous structure can also be prepared by modifying pores of the dielectric porous ceramics with high polarization loss by chemical plating method, and the metal ions of the conductive medium with high electrical conductance loss adsorbed in the plating solution in the pores being catalytically reduced to metal by the reducing agent in the plating solution and deposited on the inner surface of the pores to obtain the electric moment-electrical conductance coupling heating medium of the porous structure.

(5) Film composite structure: Metal sheets such as aluminum foils, copper foils, or copper sheets, stainless steel sheets are subjected to a single-sided or double-sided film composite using binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and the composited magnetic medium particles with high hysteresis loss and dielectric particles with high polarization loss by a casting method or a spraying method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the film composite structure. The film composite structure can also be prepared by a chemical vapor deposition method, a gas phase

pyrolysis method, a gas phase hydrolysis method, a gas phase combustion method or a flame vapor deposition method.

[0043] The present application reduces the thermal excitation temperature of the aerosol generating substrate by adsorbing the liquid phase components of the aerosol generating medium through the heating medium of the porous structure, so that the liquid phase components are differentiated into a large number of small droplets. Reference can be made to the Kelvin equation:

$$ln\frac{p_r}{p_0}=\frac{2\sigma M}{\rho RTr}$$

where p_r , p_0 are respectively the saturated vapor pressure values of small droplets and the plane liquid, σ , ρ , M are respectively the surface tension, density and molar mass of the liquid, R , T are respectively the gas constant and the absolute temperature of the gas, and r is the radius of the small droplet. Based on this, by utilizing the principle that the saturated vapor pressure value of the smaller droplets is higher than that of the larger droplets, that is, the smaller the droplet size is, the higher the saturated vapor pressure value is and the faster its evaporation rate is, a low excitation temperature aerosol generating substrate is obtained.

[0044] In a specific embodiment, the aerosol generating substrate includes a heating medium; the heating medium is selected from the first heating medium particles or the second heating medium particles. The first heating medium particles include the first dielectric medium, the first magnetic medium and the first conductive medium; the second heating medium particles include the second dielectric medium, the second magnetic medium and the second conductive medium;

[0045] In an embodiment, the first dielectric medium, the first magnetic medium, the first conductive medium, the second dielectric medium, the second magnetic medium and the second conductive medium are formed into a heating medium having one or more of a core-shell structure, a heterogeneous structure, a coating structure, a porous structure or a film composite structure that meets the multi-field coupling to generate a multi-caloric giant caloric effect through mesoscopic-scale compounding construction by physical and chemical methods.

[0046] In an embodiment, the first dielectric medium includes components with high electric moment orientation polarization loss and high thermal ion relaxation polarization loss; the first dielectric medium includes one or more of a perovskite structure system, a tungsten bronze structure system, a bismuth layered structure system and a pyrochlore structure system; the perovskite structure system includes one or more of $BaTiO_3$, $PbTiO_3$, $NaNbO_3$, $KNbO_3$ and BiFeOs; the tungsten bronze structure system includes lead metaniobate and/or $Sr_{1-x}Ba_xNb_2O_6$ (x=0 to 1.0); the bismuth layered structure system includes one or more of $SrBi_2Ta_2O_9$, $Bi_4Ti_3O_{12}$ and $SrBi_4Ti_4O_{15}$; the pyrochlore structure system includes $Cd_2Nb_2O_7$ and/or $Pb_2Nb_2O_7$.

[0047] In an embodiment, the first magnetic medium is a component with high hysteresis loss, high damping loss, high domain wall resonance loss and high natural resonance loss, preferably spinel ferrite. The spinel ferrite includes MFe_2O_4 (M = Mn, and/or Fe, and/or Ni, and/or Co, and/or Cu, and/or Mg, and/or Zn, and/or Li), and/or MnZn, and/or NiZn, and/or MgZn, and/or LiZn ferrites; and/or $R_3Fe_5O_{12}$, R is a rare earth element (Y, and/or La, and/or Pr, and/or Nd, and/or Sm, and/or Eu, and/or Gd, and/or Tb, and/or Dy, and/or Ho, and/or Er, and/or Tm, and/or Yb, and/or Lu).

[0048] In an embodiment, the second dielectric medium component is a component with high intrinsic electric moment orientation polarization loss, high thermal ion relaxation polarization loss and high resonance polarization loss; selected from (1) BaO-MgO-Ta_2O_5, and/or BaO-ZnO-Ta_2O_5, and/or BaO-MgO-Nb_2O_5, and/or BaO-ZnO-Nb_2O_5 system and their composite system; (2) $BaTi_4O_9$, and/or $BaTi_9O_{20}$, (Zr, and/or Sn)TiO_4-based system; (3) BaO-Ln_2O_3-TiO_2, and/or CaO-Li_2O-Ln_2O_3-TiO_2 (in which Ln_2O_3 is a lanthanide rare earth oxide) based system; (4) $A_5B_4O_{15}$ (A=Ba, and/or Sr, and/or Mg, and/or Zn, and/or Ca, B=Nb, and/or Ta), and/or AB_2O_6 (A=Ca, and/or Co, and/or Mn, and/or Ni, and/or Zn; B=Nb, and/or Ta); $(Ba_{1-x}M_x)ZnO_5$ (M=Ca, and/or Sr, x=0 to 1.0), $AgNb_{1-x}Ta_xO_3$ (x=0 to 1.0), and/or $LnAlO_3$ (Ln=La, and/or Nd, and/or Sm), and/or Ta_2O_5-ZrO_2, and/or $ZnTiO_3$, and/or $BiNbO_4$ series.

[0049] In an embodiment, the second magnetic medium is a component with high hysteresis loss, high damping loss, high domain wall resonance loss, high natural resonance loss, high size resonance loss and high spin wave resonance loss; the second magnetic medium is preferably selected from M-type hexagonal ferrite: BaM, and/or PbM, and/or SrM; X-type hexagonal ferrite, including Fe_2X; W-type hexagonal ferrite, including Mg_2W, and/or Mn_2W, and/or Fe_2W, and/or Co_2W, and/or Ni_2W, and/or Cu_2W, and/or Zn_2W; Y-type hexagonal ferrite, including Mg_2Y, and/or Mn_2Y, and/or Fe_2Y, and/or Co_2Y, and/or Ni_2Y, and/or Cu_2Y, and/or Zn_2Y; Z-type hexagonal ferrite, including Mg_2Z, and/or Mn_2Z, and/or Fe_2Z, and/or Co_2Z, and/or Ni_2Z, and/or Cu_2Z, and/or Zn_2Z.

[0050] The first conductive medium and/or the second conductive medium are multi-carrier high electrical conductance loss components that increase free electrons, ions, and doping defects and vacancies; the first conductive medium and/or the second conductive medium are selected from the ZnO series, including those doped with Al (AZO), and/or doped with

In (IZO), and/or doped with Ga (GZO); magnetic oxides, including CoO, and/or MnO, and/or Fe_3O_4, and/or NiO; and other semiconductor oxides, including Ga_2O_3, and/or In_2O_3, and/or InSnO (ITO). The conductive medium can be a single component as one of the composite components of the heating medium, or can be added separately or simultaneously in the dielectric medium component and the magnetic medium component.

[0051] In an embodiment, the first heating medium of the core-shell structure has three structural forms. The first structural form is electric moment-magnetic moment coupling heating medium 1-H-1 of a core-shell structure, which is obtained by using the ultrafine particles of the first magnetic medium as the core and modifying the first dielectric medium by a seed growth method, or by using the ultrafine particles of the first dielectric medium as the core and modifying the first magnetic medium component by a seed growth method; the second structural form is electric moment-electrical conductance coupling heating medium 1-H-2 of a core-shell structure, which is obtained by using the ultrafine particles of the first dielectric medium as the core and modifying the first conductive medium by the seed growth method; the third structural form is the electric moment-magnetic moment-electrical conductance coupling heating medium 1-H-3 of the core-shell structure, which is obtained by using the ultrafine particles of the first dielectric medium as the core and modifying the first magnetic medium and the first conductive medium by the seed growth method.

[0052] The first heating medium of the core-shell structure is formed through mesoscopic-scale compounding by physical and chemical methods. The specific preparation method is a direct precipitation method, or a co-precipitation method, or an alcohol salt hydrolysis method, or a sol-gel method.

[0053] In an embodiment, the first heating medium of a heterojunction structure has three structural forms. The first structural form is an electric moment-magnetic moment coupling heating medium 1-Y-1 of a heterojunction structure, which is obtained by calcining, melting and precipitating the first dielectric medium and the first magnetic medium in a uniformly mixed state; the second structural form is an electric moment-electrical conductance coupling heating medium 1-Y-2 of a heterojunction structure, which is obtained by calcining, melting and precipitating the first dielectric medium and the first conductive medium in a uniformly mixed state; the third structural form is an electric moment-magnetic moment-electrical conductance coupling heating medium 1-Y-3 of a heterojunction structure, which is obtained by calcining, melting and precipitating the first dielectric medium and the first magnetic medium and the first conductive medium in a uniformly mixed state.

[0054] The first heating medium of the heterojunction structure is formed through mesoscopic-scale compounding by physical and chemical methods. The specific preparation method is a molten salt method, or a high-temperature solid-phase reaction method, or a mechanical alloying method, and a precipitation method with controlled calcination temperature, or an alcohol salt hydrolysis method, or a hydrothermal method, or a sol (gel)-hydrothermal method.

[0055] In an embodiment, the first heating medium of the coating structure has two structural forms. The first structural form is an electric moment-magnetic moment coupling heating medium 1-B-1 of the coating structure, which is obtained by using the first magnetic medium as the mother particles and coating the ultrafine particles of the first dielectric medium; the second structural form is an electric moment-magnetic moment-electrical conductance coupling heating medium 1-B-2 of the coating structure, which is obtained by using the first magnetic medium component as the mother particles and coating the ultrafine particles of the first dielectric medium and the ultrafine particles of the conductive medium.

[0056] The first heating medium of the coating structure is formed by mesoscopic-scale compounding by physical and chemical methods. The specific preparation method is a mechanical fusion coating method, or a high-energy mill-induced mechanical force chemical effect method, or a low-heat solid phase reaction method, or sol-gel method.

[0057] In an embodiment, the first heating medium of a porous structure is the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of a porous structure.

[0058] The first heating medium 1-K of a porous structure is formed through mesoscopic-scale compounding by physical and chemical methods. The specific preparation method comprises: fully mixing the ultrafine particles of the first dielectric medium, the ultrafine particles of the first magnetic medium and the ultrafine particles of the first conductive medium with inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying;

or performing a polymer network gel method using N,N-methylenebisacrylamide network agent and ammonium sulfate to initiate a free radical polymerization reaction of acrylamide on the ultrafine particles of the first dielectric medium, the ultrafine particles of the first magnetic medium and the ultrafine particles of the first conductive medium, and then drying, sintering, crushing and classifying the obtained gel;

or performing a metal complex gel method comprising uniformly mixing ultrafine particles of the first dielectric medium into the precursor solution prepared by the first magnetic medium and the conductive medium, and adding a complexing agent to react with metal ions, and then drying, sintering, crushing and classifying the obtained soluble complex network gel;

or modifying the first dielectric medium porous body by a precipitation method using ions of the first magnetic medium component and ions of the conductive medium component in the solution and a precipitant, so that a composite film layer of the first magnetic medium component and the first conductive medium component is formed on the inner surface of the pores.

[0059] In an embodiment, the first heating medium 1-K of the porous structure has a pore size of 2nm to 50μm, and a porosity of 70% to 95%.

[0060] The present application preferably selects the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure to obtain the heating medium 1-D of the low excitation temperature aerosol generating substrate. Specifically, the heating medium 1-D of the low excitation temperature aerosol generating substrate is prepared from a method comprising from the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure, selecting particles satisfying principle conditions of the Kelvin equation with a pore size ranging from 60nm to 50μm, a porosity ranging from 85% to 95%, a specific heat capacity ranging from 0.1 $kJ\cdot kg^{-1}\cdot K^{-1}$ to 0.6 $kJ\cdot kg^{-1}K^{-1}$, and a coefficient of thermal conductivity ranging from 0.035 $W\cdot m^{-1}\cdot K^{-1}$ to 0.125 $W\cdot m^{-1}\cdot K^{-1}$ to adsorb the liquid phase components of the aerosol generating medium, so that the liquid phase components are separated into small droplets entering the pores with a porosity of 85% to 95% and a pore size ranging from 60nm to 50μm, to increase the saturated vapor pressure value of the liquid phase component of the aerosol generating medium, and obtain the heating medium of the low excitation temperature aerosol generating substrate, wherein the excitation temperature is 160°C to 200°C, and the particle size distribution range of the heating medium 1-D of the low excitation temperature aerosol generating substrate is 15μm to 500μm.

[0061] In an embodiment, the first heating medium of the film composite structure is the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M of the film composite structure, which is prepared through a mesoscopic-scale compounding by physical and chemical methods; the specific preparation method of forming the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M of the film composite structure comprises fully mixing the binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide with the ultrafine particles of the first dielectric medium, the ultrafine particles of the first magnetic medium, and the ultrafine particles of the first conductive medium, and then performing a single-sided or double-sided film composite on the aluminum sheet, copper sheet, or stainless steel sheet by a spraying method or a brushing method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M of the film composite structure; or performing a chemical vapor deposition method, or a gas phase pyrolysis method, or a gas phase hydrolysis method, or a gas phase combustion method, or a flame vapor deposition method, or a plasma spraying method to prepare the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M of the film composite structure.

[0062] In an embodiment, the second heating medium of the core-shell structure has three structural forms. The first structural form is electric moment-magnetic moment coupled heating medium 2-H-1 of a core-shell structure, which is obtained by using ultrafine particles of the second magnetic medium as the core and modifying the second dielectric medium by a seed growth method; or is obtained by using ultrafine particles of the second dielectric medium as the core and modifying the second magnetic medium by a seed growth method; the second structural form is electric moment-electrical conductance coupling heating medium 2-H-2 of a core-shell structure, which is obtained by using ultrafine particles of the second dielectric medium as the core and modifying the conductive medium component material by a seed growth method; the third structural form is electric moment-magnetic moment-electrical conductance coupling heating medium 2-H-3 of a core-shell structure, which is obtained by using ultrafine particles of the second dielectric medium as the core and modifying the second magnetic medium component material and the conductive medium component material by a seed growth method.

[0063] The second heating medium of the core-shell structure is formed through mesoscopic-scale compounding by physical and chemical methods. The specific preparation method is a direct precipitation method, a co-precipitation method, an alcohol salt hydrolysis method or a sol-gel method.

[0064] In an embodiment, the second heating medium of a heterojunction structure has three structural forms. The first structural form is the electric moment-magnetic moment coupling heating medium 2-Y-1 of a heterojunction structure, which is obtained by calcining, melting and precipitating the second dielectric medium component particles and the second magnetic medium component particles in a uniformly mixed state; the second structural form is the electric moment-electrical conductance coupling heating medium 2-Y-2 of a heterojunction structure, which is obtained by calcining, melting and precipitating the second dielectric medium component particles and the second conductive medium component particles in a uniformly mixed state; the third structural form is the electric moment-magnetic moment-electrical conductance coupling heating medium 3-Y-3 of a heterojunction structure, which is obtained by calcining, melting and precipitating the second dielectric medium component particles, the second magnetic medium component particles and the second conductive medium component particles in a uniformly mixed state.

[0065] The second heating medium of a heterojunction structure is formed through mesoscopic-scale compounding by physical and chemical methods. The specific preparation methods are a molten salt method, a high-temperature solid phase reaction method, a mechanical alloying method, a precipitation method with controlled calcination temperature, an alcohol salt hydrolysis method, hydrothermal method, or a sol (gel)-hydrothermal method.

[0066] In an embodiment, the second heating medium of the coating structure has two structural forms. The first structural form is electric moment-magnetic moment coupling heating medium 2-B-1 of a coating structure, which is obtained by using the second magnetic medium component as mother particles and coating the ultrafine particles of the second dielectric medium component; the second structural form is electric moment-magnetic moment-electrical conductance coupling heating medium 2-B-2 of a coating structure, which is obtained by using the second magnetic medium component as mother particles and coating the ultrafine particles of the second dielectric medium component and the ultrafine particles of the conductive medium component.

[0067] The second heating medium of the coating structure is formed through mesoscopic-scale compounding by physical and chemical methods. The specific preparation method is a mechanical fusion coating method, or a high-energy mill-induced mechanical force chemical effect method, or a low-heat solid phase reaction method and a sol-gel method.

[0068] In an embodiment, the second heating medium of a porous structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of a porous structure, which is prepared through a mesoscopic-scale compounding by physical and chemical methods. The specific preparation method of forming the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of a porous structure comprises fully mixing the ultrafine particles of the second dielectric medium component, the ultrafine particles of the second magnetic medium component, and the ultrafine particles of the conductive medium component with an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and a pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying; or performing a polymer network gel method using N,N-methylenebisacrylamide network agent and ammonium sulfate to initiate a free radical polymerization reaction of acrylamide on the ultrafine particles of the second dielectric medium, the ultrafine particles of the second magnetic medium and the ultrafine particles of the second conductive medium, and then drying, sintering, crushing and classifying the obtained gel; or performing a metal complex gel method comprising uniformly mixing ultrafine particles of the second dielectric medium into the precursor solution prepared by the second magnetic medium and the conductive medium, and adding a complexing agent to react with metal ions, and then drying, sintering, crushing and classifying the obtained soluble complex network gel; or modifying the second dielectric medium porous body by a precipitation method using ions of the second magnetic medium component and ions of the conductive medium component in the solution and a precipitant, so that a composite film layer of the second magnetic medium component and the conductive medium component is formed on the inner surface of the pores; the porous structure has a pore size of 2nm to 50μm, and a porosity of 70% to 95%.

[0069] In an embodiment, the second heating medium of a porous structure may be a heating medium 2-D of a low excitation temperature aerosol generating substrate. The heating medium 2-D of the low excitation temperature aerosol generating substrate is prepared from a method comprising from the electric moment-magnetic moment-conductance coupling heating medium 2-K of the porous structure, selecting particles with physical property parameters that meet the principle conditions of the Kelvin equation with a pore size ranging from 60nm to 50μm, a porosity ranging from 85% to 95%, a specific heat capacity ranging from 0.1 $kJ\cdot kg^{-1}\cdot K^{-1}$ to 0.6 $kJ\cdot kg^{-1}\cdot K^{-1}$, and a coefficient of thermal conductivity ranging from 0.035 $W\cdot m^{-1}\cdot K^{-1}$ to 0.125 $W\cdot m^{-1}\cdot K^{-1}$ to adsorb the liquid phase components of the aerosol generating medium, so that the liquid phase components are separated into small droplets entering the pores with a porosity of 85% to 95%, and the pore size ranging from 60nm to 50μm, to increase the saturated vapor pressure value of the liquid phase component of the aerosol generating medium, and obtain the heating medium of the low excitation temperature aerosol generating substrate, wherein the excitation temperature is 160°C to 200°C, and the particle size distribution range of the heating medium 2-D particles of the low excitation temperature aerosol generating substrate is 15μm to 500μm.

[0070] In an embodiment, the second heating medium of a film composite structure is electric moment-magnetic moment-electrical conductance coupling heating medium 2-M of a film composite structure, which is prepared through a mesoscopic-scale compounding by physical and chemical methods. The specific preparation method of the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M of the film composite structure comprises fully mixing the binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide with ultrafine particles of the second dielectric medium component, ultrafine particles of the second magnetic medium component and ultrafine particles of the conductive medium component, and then performing a single-sided or double-sided film composite on the aluminum sheet, copper sheet or stainless steel sheet by a spraying method or a brushing method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M of the film composite structure; or performing a chemical vapor deposition method, a gas phase pyrolysis method, a gas phase hydrolysis method, a gas phase combustion method, a flame vapor deposition method, or a plasma spraying method to prepare the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M of the film composite structure.

[0071] In an embodiment, the particle size distribution range of the particles of the first dielectric medium component, or the particles of the first magnetic medium component, or the particles of the second dielectric medium component, or the particles of the second magnetic medium component, or the particles of the first conductive medium component is 20nm to 200μm. The particle size of the ultrafine particles of the first dielectric medium component, or the ultrafine particles of the first magnetic medium component, or the ultrafine particles of the second dielectric medium component, or the ultrafine particles of the second magnetic medium component, or the ultrafine particles of the second conductive medium component is 20nm to 10μm; the ultrafine particles meet the physical property requirements of the dense ultrafine particle aggregates to absorb electromagnetic waves and generate heat.

[0072] In an embodiment, the heating structure of the aerosol generating system includes three structures, namely, heating structure A of the aerosol generating system, heating structure B of the aerosol generating system and heating structure C of the aerosol generating system.

[0073] The heating structure A of the aerosol generating system is composed of a heating chamber a, a preheating shell, an aerosol generating section, an aerosol generating substrate, a particle heating medium, a gas-mist substrate, a foil-like film composite heating medium, a metal particle layer filter medium, a sealing ring, a temperature control unit, and the like. The main structural relationship is that the heating chamber a composed of a tubular electrode plate is fixedly connected to the middle part of the preheating shell; the aerosol generating section is placed in the central axial hole tube of the heating chamber a; the aerosol generating section contains an aerosol generating substrate, which contains a particle heating medium and a gas-mist substrate; a foil-like film composite heating medium with a size comparable to that of tobacco sheets can also be added; a metal particle layer filter medium is sandwiched between the aerosol generating section and the filter section; the upper end of the heating chamber a is connected to the sealing ring and nested in the upper part of the preheating shell; the temperature control unit passes through the central hole of the heating chamber a base and is placed in the aerosol generating section for 2 to 5mm; the base disc of the heating chamber a is uniformly distributed with 8 to 36 through holes with a diameter of 0.3 to 2mm. The heating chamber a base is an insulating Al_2O_3 ceramic.

[0074] The heating structure B of the aerosol generating system is composed of a heating chamber b, a preheating shell, an aerosol generating section, an aerosol generating substrate, a particle heating medium, a gas-mist substrate, a foil-like film composite heating medium, a metal particle layer filter medium, a sealing ring and a temperature control unit, and the like. The main structural relationship is that the heating chamber b composed of a planar electrode plate and a block heating medium 1 is fixedly connected to the middle part of the preheating shell; the aerosol generating section is placed in the central axial hole tube of the heating chamber b; the aerosol generating section contains an aerosol generating substrate, which contains a particle heating medium and a gas-mist substrate; a foil-like film composite heating medium with a size comparable to that of tobacco sheets can also be added; a metal particle layer filter medium is sandwiched between the aerosol generating section and the filter section; the upper end of the heating chamber b is connected to the sealing ring and nested in the upper part of the preheating shell; the temperature control unit passes through the central hole of the heating chamber b base and enters the aerosol generating section for 2 to 5mm; the base disc of the heating chamber a is uniformly distributed with 8 to 36 through holes with a diameter of 0.3 to 2mm; the heating chamber b base is an insulating Al_2O_3 ceramic. The block heating medium 1 is a type of the block heating medium.

[0075] The heating structure C of the aerosol generating system is composed of a heating chamber c, a preheating shell, an aerosol generating section, an aerosol generating substrate, a particle heating medium, a gas-mist substrate, a foil-like film composite heating medium, a metal particle layer filter medium, a wave-transmitting ceramic tube and a temperature control unit, and the like. The main structural relationship is that the heating chamber c composed of a cubic block heating medium 2 is fixedly connected to the middle part of the preheating shell; the aerosol generating section is placed in the central axial hole tube of the heating chamber c; the aerosol generating section contains an aerosol generating substrate, which contains a particle heating medium and a gas-mist substrate; a foil-like film composite heating medium with a size comparable to that of tobacco sheets can also be added; a metal particle layer filter medium is sandwiched between the aerosol generating section and the filter section; a wave-transmitting ceramic sealing tube is nested in the central axis of the heating chamber c; the wave-transmitting ceramic tube is in a material of quartz ceramic SiO_2 or high alumina ceramic Al_2O_3 or Si_3N_4 ceramic; and the temperature control unit is arranged at the lower side wall of the bottom c of the heating chamber. The bulk heating medium 2 is one of the bulk heating medium.

[0076] In an embodiment, the heating chamber a is composed of a tubular electrode plate, which is formed by compounding a curved electrode 1 and a curved electrode 2 on the inner surface of a tubular insulating ceramic substrate. The curved electrode 1 and the curved electrode 2 are arranged in pieces and are opposite to each other, and the curved electrode 1 and the curved electrode 2 are both in 2 to 5 pieces. Preferably, the curved electrode 1 and the curved electrode 2 are both in 3 pieces, which are spaced and opposite to each other. The adjacent curved electrodes 1 and 2 are separated by insulating Al_2O_3 ceramics, and can also be filled with insulating materials such as polyimide or aramid resin (poly(m-phenylene isophthalamide)). The curved electrode 1 and the curved electrode 2 are both copper or silver thin sheet materials. The length of the heating chamber a is equivalent to the aerosol generating section, and the diameter is well known in the art. The heating chamber a is used for heating when the frequency of the alternating electromagnetic field is in the range of 0.3MHz to 300MHz. The curved electrode 1 is a type of the electrode 1, and the curved electrode 2 is a type of the electrode 2.

[0077] The heating chamber b is composed of a planar electrode plate 1, a planar electrode plate 2 and a block heating medium 1. The planar electrode plate 1 and the planar electrode plate 2 are arranged parallelly and are opposite to each other, and the space therebetween is the diameter value of the aerosol generating section. A block heating medium 1 is sandwiched between each of two pairs of corresponding ends of the planar electrode plate 1 and the planar electrode plate 2. A cylindrical hole is arranged at the symmetric center of the two sandwiched block heating media 1, and the diameter of the cylindrical hole is the diameter value of the aerosol generating section, and the length of the cylindrical hole is the length value of the aerosol generating section. The heating chamber b is used for heating when the alternating electromagnetic field frequency is in the range of 0.3MHz to 300MHz. The planar electrode 1 is a type of the electrode 1, and the planar electrode 2 is a type of the electrode 2.

[0078] The heating chamber c is composed of a block heating medium 2, a metal shielding shell and an antenna (such as a PIFA planar inverted F antenna) embedded in the block heating medium 2. The block heating medium 2 is in a cubic shape, and a cylindrical hole is arranged at the symmetry axis. The hole depth is the length value of the aerosol generating section. A wave-transmitting ceramic tube is nested in the cylindrical hole, and the inner diameter of the wave-transmitting ceramic tube is the diameter value of the aerosol generating section. An antenna (such as a PIFA planar inverted F antenna) is embedded in the block heating medium 2 below the air inlet seat hole corresponding to the heating chamber c, and the antenna feeder pin extends to the outside of the block heating medium 2. An air inlet connected to the cylindrical hole is arranged at the symmetry axis of the block heating medium 2 between the lower cylindrical hole and the antenna. The air inlet is connected to the outside of the block heating medium 2 through several small holes, and the metal shielding shell seals the block heating medium 2. The heating chamber c is used for heating when the alternating electromagnetic field frequency is in the range of 0.3GHz to 30GHz.

[0079] In an embodiment, the preheating shell is composed of a metal shielding shell surrounding the heating chamber a, or surrounding the heating chamber b, or surrounding the heating chamber c, and a shell having a certain gap with the outer wall of the metal shielding shell of the heating chamber a, or the heating chamber b, or the heating chamber c. The gap is about 1.5 to 3mm. The base material of the preheating shell is hexagonal boron carbon nitrogen ternary wave absorbing ceramic (h-BCN). The inner wall of the preheating shell is coated with a particle coating of a heating medium. The film-forming agent is sodium silicate sol, or aluminum dihydrogen phosphate sol, or aluminum hydroxide sol, or silica sol. Sintering and solidifying are performed at a high temperature of more than 800°C.

[0080] The room temperature airflow flows through the gap space from the air inlet, is preheated, and is then introduced into the heating chamber a, or the heating chamber b, or the heating chamber c. The preheating shell is made of the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M material of the film composite structure, and is used to surround the heating chamber a or the heating chamber b; or the preheating shell is made of the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M material of the film composite structure, and is used to surround the heating chamber c.

[0081] In an embodiment, the aerosol generating section contains an aerosol generating substrate and a metal particle layer filter medium, or also contains a foil-like film composite heating medium cut to a size equivalent to that of a tobacco sheet. The shape of the foil-like film composite heating medium is cigarette-shaped, and the size is well known in the art. The mixing mass ratio of the foil-like film composite heating medium is 3-30%. Specifically, the aerosol generating section 1 is composed of an aerosol generating substrate 1 and a metal particle layer filter medium or contains the foil-like film composite heating medium 1-M, forming a structure that can be connected to the cigarette filter section. One end of the aerosol generating section 1 is connected to the filter section, and the other end is a free end. The metal particle layer filter medium is located between the connection interface of the filter section and the aerosol generating section 1. The aerosol generating section 2 is composed of an aerosol generating substrate 2 and a metal particle layer filter medium or contains the foil-like film composite heating medium 2-M, forming a structure that can be connected to the cigarette filter section. One end of the aerosol generating section 2 is connected to the filter section, and the other end is a free end. The metal particle layer filter medium is located between the connection interface of the filter section and the aerosol generating section 2.

[0082] One end of the aerosol generating substrate is a free end, and the other end is connected to the filter section. The metal particle layer filter medium is located between the connection interface. The filter section can be a common filter well known in the art, or it can be a new type of filter with special cooling, adsorption and filtering functions.

[0083] The aerosol generating substrate is composed of a particle heating medium and a gas-mist substrate. The particle heating medium is directly blended with the gas-mist substrate, or the particle heating medium is mixed into the fiber slurry or paste before the tobacco sheet in the gas-mist substrate is manufactured or roller-pressed, so that the tobacco sheet is uniformly distributed with a particle heating medium of 5% to 60% by mass, or the particle heating medium of a porous structure or the low excitation temperature aerosol generating substrate adsorbs the liquid phase component in the gas-mist substrate, and then blends with the particle heating medium and the gas-mist substrate. The liquid phase component in the gas-mist substrate is well known in the art; except for the liquid phase component, the other components in the smoke substrate are composed of various monomer substrates and substrate carriers well known in the art.

[0084] In a specific embodiment, the aerosol generating substrate 1 is composed of the first heating medium particles and the gas-mist substrate, the first heating medium particles are directly blended with the gas-mist substrate, wherein the particle size distribution range of the first heating medium particles is 15 μm to 500 μm; or the first heating medium particles are mixed into the fiber slurry or paste before the tobacco sheet in the gas-mist substrate is manufactured or roller-pressed, so that the tobacco sheet is uniformly distributed with the first heating medium particles with a mass ratio of 5% to 60%, wherein the particle size distribution range of the first heating medium particles is 0.1 μm to 100 μm; or the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K particles of a porous structure adsorb the liquid phase components in the gas-mist substrate and then blend with other gas-mist substrate, wherein the particle size distribution range of the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K particles of the porous structure is 15μm to 500μm; or the heating medium 1-D particles of the low excitation temperature aerosol generating substrate adsorb the liquid phase components in the gas-mist substrate and then blend with other gas-mist substrate, wherein the particle size distribution range of the heating medium 1-D particles of the low excitation temperature aerosol generating substrate is 15μm to 500μm. The aerosol generating substrate 2 is composed of the second heating medium particles and the gas-mist substrate, the second heating medium particles are directly blended with the gas-mist substrate, wherein the particle size distribution range of the second heating medium particles is 15 μm to 500 μm; or the second heating medium particles are mixed into the fiber slurry or paste before the tobacco sheet in the gas-mist substrate is manufactured or roller-pressed, so that the tobacco sheet is uniformly distributed with the second heating medium particles with a mass ratio of 5% to 60%, wherein the particle size distribution range of the second heating medium particles is 0.1 μm to 100 μm; or the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of a porous structure absorbs the liquid phase components in the gas-mist substrate and then blends with other gas-mist substrate, wherein the particle size distribution range of the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K particles of the porous structure is 15μm to 500μm; or the heating medium 2-D of the low excitation temperature aerosol generating substrate absorbs the liquid phase components in the gas-mist substrate and then blends with other gas-mist substrate, wherein the particle size distribution range of the heating medium 2-D particles of the low excitation temperature aerosol generating substrate is 15μm to 500μm.

[0085] The particle heating medium is compositely constructed by a multi-component physical and chemical method using the dielectric medium with high polarization loss, magnetic medium with high hysteresis loss and conductive medium with high electrical conductance loss, and has one structure selected from the group consisting of a core-shell structure, a heterojunction structure, a coating structure, a porous structure, and a mixture thereof, and the particle size distribution range is 0.1μm to 500μm, where the particle heating medium directly blended with the gas-mist substrate has a particle size distribution range of 15μm to 500μm; the particle heating medium added to the manufactured slurry or roller-pressed paste of the tobacco sheet has a particle size distribution range of 0.1μm to 100μm.

[0086] The block heating medium is compositely constructed by a multi-component physical and chemical method using the dielectric medium with high polarization loss, magnetic medium with high hysteresis loss and conductive medium with high electrical conductance loss, and has one structure selected from the group consisting of a core-shell structure, a heterojunction structure, a coating structure, a porous structure, and a mixture thereof, and is formed by mixing with an inorganic binder such as sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and then performing pressing and low-temperature calcination. In a specific case, the block heating medium 1 is formed by mixing the first heating medium with an inorganic binder such as sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and then pressing and low-temperature calcination; the block heating medium 2 is formed by mixing the second heating medium with an inorganic binder such as sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and then pressing and low-temperature calcination.

[0087] The foil-like film composite heating medium is compositely constructed by a multi-component physical and chemical method using the dielectric medium with high polarization loss, magnetic medium with high hysteresis loss and conductive medium with high electrical conductance loss, and has one structure selected from the group consisting of a core-shell structure, a heterojunction structure, a coating structure, a porous structure, and a mixture thereof, and is formed by performing a single-sided or double-sided film composite on an aluminum foil or copper foil using a casting method or a spraying method, or other preparation methods such as a chemical vapor deposition method, a gas phase pyrolysis method, a gas phase hydrolysis method, a gas phase combustion method and a flame vapor deposition method, and then cutting to a size equivalent to that of tobacco sheets.

[0088] The metal particle layer filter medium is formed by pressing aluminum particles with a size of 0.5 to 1mm and a thickness of about 0.5 to 2mm.

[0089] The present application provides an aerosol generating system using multi-caloric coupling giant caloric effect, wherein the aerosol generating system comprises a heating structure, the heating structure comprises a housing, and the housing is provided with a housing air inlet;

a preheating shell is provided inside the housing; the housing and the preheating shell are coaxially opened;

the opening of the preheating shell is connected to the filter section; the preheating shell is provided with a preheating shell air inlet;

a plurality of electrode plates are provided inside the preheating shell; the plurality of electrode plates form a heating chamber;

a heating chamber base is provided at the bottom of the heating chamber; a temperature control unit passes through the central hole of the heating chamber base, and a base disc air inlet is provided on the heating chamber base;

the upper end of the heating chamber is connected to a sealing ring and nested in the opening of the preheating shell;

the interior of the electrode plate is an aerosol generating section; a metal particle layer filter medium is provided between the aerosol generating section and the filter section;

the aerosol generating section contains an aerosol generating substrate 1;

the electrode plate is connected to a heating drive unit through an electrode plate feeder;

[0090] The aerosol generating substrate 1 comprises the first heating medium.

[0091] The present application provides an aerosol generating system using the multi-caloric coupling giant caloric effect, wherein the aerosol generating system comprises a heating structure, the heating structure comprises a housing, the housing is provided with a housing air inlet;

a preheating shell is provided inside the housing; the housing and the preheating shell are coaxially opened;

the opening of the preheating shell is connected to the filter section; the preheating shell is provided with a preheating shell air inlet;

a metal shielding shell, a block heating medium 2 and an antenna embedded in the block heating medium 2 are provided inside the preheating shell; the metal shielding shell is wrapped around the outside of the block heating medium 2;

the metal shielding shell, the block heating medium 2 and the antenna embedded in the block heating medium 2 form a heating chamber;

an air inlet seat hole of the heating chamber communicates with the outside of the block heating medium 2 through 4 to 10 air inlet channels with a diameter of 0.5 to 2mm;

the block heating medium 2 is a cube; a cylindrical hole is arranged at the symmetry axis of the block heating medium 2, and an aerosol generating section is formed inside the hole; a wave-transmitting ceramic tube is nested in the cylindrical hole, and the inner diameter of the wave-transmitting ceramic tube is the diameter of the aerosol generating section;

the upper end of the heating chamber is connected to the sealing ring and nested in the opening of the preheating shell;

a metal particle layer filter medium is provided between the aerosol generating section and the filter section;

the aerosol generating section contains an aerosol generating substrate 2;

the antenna is connected to the heating drive unit through an antenna feeder pin;

the aerosol generating substrate 2 comprises the second heating medium.

[0092] In an embodiment, the aerosol generating system has three forms, namely the first aerosol generating system form, the second aerosol generating system form and the third aerosol generating system form, which respectively have heating structure A of the aerosol generating system, heating structure B of the aerosol generating system and heating structure C of the aerosol generating system, where:

[0093] The first aerosol generating system form is mainly composed of an aerosol generating section, an aerosol generating substrate, a metal particle layer filter medium, or a foil-like film composite heating medium, and a heating chamber a, a tubular electrode plate, a curved electrode 1 and a curved electrode 2, a tubular insulating ceramic substrate, a heating chamber a base, a temperature control unit, a preheating shell, a heating drive unit and a housing, where the heating drive unit is composed of a power amplifier and control, an alternating electromagnetic field generator and a battery, and the alternating voltage provided by the power amplifier and the control unit is connected to the curved electrode 1 and the curved electrode 2 respectively through a feeder.

[0094] The second aerosol generating system form is mainly composed of an aerosol generating section, an aerosol generating substrate, a metal particle layer filter medium, or a foil-like film composite heating medium, and a heating chamber b, a planar electrode 1 and a planar electrode 2, a block heating medium 1, a heating chamber b base, a temperature control unit, a preheating shell, a heating drive unit and a housing, where the heating drive unit is composed of a power amplifier and control, an alternating electromagnetic field generator and a battery, and the alternating voltage provided by the power amplifier and control unit is connected to the planar electrode 1 and the planar electrode 2 respectively through the feeder.

[0095] The third aerosol generating system form is mainly composed of an aerosol generating section, an aerosol generating substrate, a metal particle layer filter medium, or a foil-like film composite heating medium, and a heating chamber c, a block heating medium 2, a wave-transmitting ceramic tube, an antenna embedded in the block heating medium 2, an antenna feeder pin, a PCB circuit board, a temperature control unit, a metal shielding shell, a preheating shell, a heating drive unit and a housing, where the heating drive unit is composed of a power amplifier and control, an alternating electromagnetic field generator and a battery.

[0096] In the heating drive units of the three aerosol generating system forms, the used alternating electromagnetic field frequency range is 0.3MHz to 30GHz; where the frequency range used by the first aerosol generating system form and the second aerosol generating system form is 0.3MHz to 300MHz, which can meet the matching requirements of multi-caloric coupling of electric caloric, magnetic caloric and conductive caloric for multi-field coupling drive, and has a frequency range that is compatible with and balances the multi-caloric coupling response frequency. That is, within this frequency range, the dielectric medium component can enhance the relaxation polarization loss of the inherent electric moment orientation polarization and the thermal ion relaxation polarization; the magnetic medium component can increase the hysteresis loss and damping loss and the domain wall resonance and natural resonance in the resonance loss; the conductive medium component can increase the electrical conductance loss of carriers such as free electrons and ions and the wave absorption loss of dense ultrafine particle aggregates. The frequency range used by the third aerosol generating system is 0.3GHz to 30GHz, which can meet the matching requirements of multi-caloric coupling of electric caloric, magnetic caloric and conductive caloric for multi-field coupling drive, and has a frequency range that is compatible with and balances the multi-caloric coupling response frequency. That is, within this frequency range, the dielectric medium component can enhance the relaxation polarization loss of the inherent electric moment orientation polarization and the thermal ion relaxation polarization, as well as the resonant polarization loss of the ion displacement polarization; the magnetic medium component can increase the hysteresis loss and damping loss, as well as the domain wall resonance, natural resonance, size resonance, and spin wave resonance in the resonance loss; the conductive medium component can increase the electrical conductance loss of carriers such as free electrons and ions and the wave absorption loss of dense ultrafine particle aggregates.

[0097] <u>In order to explain the aerosol system using multi-caloric coupling giant caloric effect of the present application in detail, please refer to the following content:</u>

Reference is made to Figures 1 to 6. The materials and unit structures involved in the first aerosol system form (01) of the aerosol system and method mainly utilizing the multi-caloric coupling giant caloric effect include: an aerosol generating section 1 (011), a preheating shell (012), a heating chamber a (013), an electrode plate feeder (014), a power amplifier and control (015), an alternating electromagnetic field generator (016), a battery (017), a housing (018), and a metal particle layer filter medium (0111) (to prevent electromagnetic wave radiation leakage), an aerosol generating substrate 1 (0112), first heating medium particles (0113), a foil-like film composite heating medium 1 (0114), a preheating shell air inlet (0121), a housing air inlet (0181), a preheating shell substrate (0122), a first heating medium particle coating (0123), a sealing ring (0131), a tubular electrode plate (0132), a heating chamber a base (0133), a temperature control unit (0134), a base disc air inlet (0135), a curved electrode 1 (01321) and a curved electrode 2 (01322), a gap insulating material (01323), a feeder connection position (01324) of curved electrode 2 and curved electrode 1 (01325).

[0098] In the present application, the specific method for preparing the first heating medium particles (0113), the foil-like film composite heating medium 1 (0114) and the aerosol generating substrate 1 (0112), as well as the preparation basis and method of the curved electrode 1 (01321) and the curved electrode 2 (01322) of the tubular electrode plate (0132), and the first heating medium particle coating (0123), and the steps thereof involved in the first aerosol generating system form (01) of the aerosol generating system and method utilizing the multi-caloric coupling giant caloric effect as shown in FIG. 1, in the heating structure A of the aerosol generating system at the A-A section as shown in FIG. 2 and FIG. 3, in the aerosol generating section 1 at the A-A section containing a foil-like film composite heating medium 1 as shown in FIG. 4 and FIG. 5, and in the curved electrode 1 and the curved electrode 2 of the tubular electrode plate as shown in FIG. 6 are as follows:

In the first aerosol generating system form (01) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect, the alternating electromagnetic field frequency range used by the heating drive unit is 0.3MHz to 300MHz, and the design principle of being compatible with and balancing the multi-caloric coupling frequency response range is: for dielectric medium components, enhancing the relaxation polarization loss of inherent electric moment orientation polarization and hot ion relaxation polarization; for magnetic medium components, increasing hysteresis loss and damping loss and domain wall resonance loss; for conductive medium components, increasing the electrical conductance loss of carriers such as free electrons and ions and the wave absorption loss of dense ultrafine particle aggregates, wherein the heating medium particles suitable for the first aerosol generating system form (01) are referred to as the first heating medium particles in the present application.

[0099] In an embodiment, the design method of the first heating medium particles is to compositely construct the dielectric medium, magnetic medium and conductive medium by a physical and chemical method of multi-phase components, wherein the heating medium adopts one or more structures of core-shell structure, heterojunction structure, coating structure, porous structure and film composite structure, to make the dielectric medium, magnetic medium and conductive medium be composited at the mesoscopic scale in each structure.

[0100] **Step 1-1,** the preparation of the first heating medium particles (0113) used in the first aerosol generating system form (01) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect is as follows:

(1) The components of the dielectric medium include components that enhance the intrinsic electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss. The components include: (1) perovskite structure system, including $BaTiO_3$, and/or $PbTiO_3$, and/or $NaNbO_3$, and/or $KNbO_3$, and/or BiFeOs; (2) tungsten bronze structure system, including lead metaniobate, and/or $Sr_{1-x}Ba_xNb_2O_6$; (3) bismuth layered structure system, including $SrBi_2Ta_2O_9$, and/or $Bi_4Ti_3O_{12}$, and/or $SrBi_4Ti_4O_{15}$; (4) pyrochlore structure system, including $Cd_2Nb_2O_7$, and/or $Pb_2Nb_2O_7$.

(2) The components of the magnetic medium include components that increase hysteresis loss, damping loss and domain wall resonance loss, and increase the wave absorption loss of dense ultrafine particle aggregates. The components include: spinel ferrite, including MFe_2O_4 (M = Mn, and/or Fe, and/or Ni, and/or Co, and/or Cu, and/or Mg, and/or Zn, and/or Li), and/or MnZn, and/or NiZn, and/or MgZn, and/or LiZn ferrite; and/or $R_3Fe_5O_{12}$, R is a rare earth element (Y, and/or La, and/or Pr, and/or Nd, and/or Sm, and/or Eu, and/or Gd, and/or Tb, and/or Dy, and/or Ho, and/or Er, and/or Tm, and/or Yb, and/or Lu)

(3) The components of the conductive medium include components that increase carriers such as free electrons, ions, and doping defects and vacancies. The conductive medium can be a single component as one of the composite components of the heating medium, or it can be added separately or simultaneously to the dielectric medium component and the magnetic medium component. The conductive medium components include: ZnO series, including those doped with Al (AZO), and/or doped with In (IZO), and/or doped with Ga (GZO); magnetic oxides, including CoO, and/or MnO, and/or Fe_3O_4, and/or NiO; and other semiconductor oxides, including Ga_2O_3, and/or In_2O_3, and/or InSnO (ITO).

(4) The present application performs a composite construction of the dielectric medium, magnetic medium and conductive medium by a physical and chemical method of multi-phase components:

Firstly, the ultrafine component particles that increase the hysteresis loss, damping loss and domain wall resonance loss, and increase the wave absorption loss of the dense ultrafine particle aggregates are used as the core, or the ultrafine component particles that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss are used as the core, by means of direct precipitation method or co-precipitation method, or alcohol salt hydrolysis method or sol-gel method, using a precipitating agent, the precipitates of the ultrafine component ions that can enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss, or the ultrafine component ions that increase the hysteresis loss, damping loss and domain wall resonance loss, and increase the wave absorption loss of the dense ultrafine particle aggregates, or the ultrafine component ions that increase the carriers such as free electrons, ions and doping defects and vacancies are modified to the surface of the core particles, and calcined, to obtain the electric moment-magnetic moment coupling heating medium of the core-shell structure, or the electric moment-electrical conductance coupling heating medium of the core-shell structure.

Secondly, by molten salt method, or high-heat solid-phase reaction method or mechanical alloying method, the ultrafine component particles that enhance inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss are uniformly mixed with the ultrafine component particles that increase the hysteresis loss, damping loss and domain wall resonance loss, and increase the wave absorption loss of dense ultrafine particle aggregates; or the ultrafine component particles that enhance inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss are uniformly mixed with the ultrafine component particles that increase the carriers such as free electrons, ions, doping defects and vacancies; or the ultrafine component particles that increase the hysteresis loss, damping loss and domain wall resonance loss, and increase the wave absorption loss of dense ultrafine particle aggregates are uniformly mixed with the ultrafine component particles that increase the carriers such as free electrons, ions, doping defects and vacancies, and are calcined, and melted and precipitated in the heterogeneous contact interface region to obtain the electric moment-magnetic moment coupling heating medium of the heterojunction structure; or to obtain the electric moment-electrical conductance coupling heating medium of the heterojunction structure; or to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the heterojunction structure. The electric moment-magnetic moment coupling heating medium of the heterojunction structure; or the electric moment-electrical conductance coupling heating medium of the heterojunction structure; or the electric moment-magnetic moment-electrical conductance coupling heating medium of the heterojunction structure can also be obtained by epitaxial growth in the heterogeneous contact interface region by a precipitation method with controlled calcination temperature, or an alcohol salt hydrolysis method, or a hydrothermal method, or a sol (gel)-hydrothermal method, or the like.

Thirdly, the ultrafine components that increase the hysteresis loss, damping loss and domain wall resonance loss and increase the wave absorption loss of dense ultrafine particle aggregates are used as mother particles to coat the ultrafine component sub-particles that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss, or the ultrafine components that increase the hysteresis loss, damping loss and domain wall resonance loss and increase the wave absorption loss of dense ultrafine particle aggregates are used as mother particles to coat the ultrafine component sub-particles that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss and the ultrafine component sub-particles that increase the carriers such as free electrons, ions and doping defects and vacancies, and the mechanical chemical effect caused by mechanical forces such as shearing, friction, extrusion and impact of mechanical fusion coating equipment is used to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the coating structure. For the ultrafine component particles that increase the hysteresis loss, damping loss and domain wall resonance loss and increase the wave absorption loss of the dense ultrafine particle aggregates, and the ultrafine component particles that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss, that are slightly soluble in water or contain water of crystallization, they can be fully mixed and crushed by a low-heat solid-phase reaction method to form a cold melt layer on the surface of the particles; the precipitated ions diffuse with each other in the cold melt layer; as the grinding process continues, new cold melt layers are continuously formed on the surface of the particles; the cold melt layer on the surface of each particle is equivalent to a micro-reaction zone, and the generated products nucleate and grow to obtain an electric moment-magnetic moment-electrical conductance coupling heating medium of the coating structure. Alternatively, the colloidal particle dispersion system formed by the ultrafine components that increase the hysteresis loss, damping loss and domain wall resonance loss, and increase the wave absorption loss of the dense ultrafine particle aggregates, and the ultrafine components that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss, that can undergo condensation reaction, can be further aggregated and bonded to form a three-dimensional network structure through a sol-gel condensation reaction, and then digested by low-temperature heat treatment and sintered at high temperature to obtain the electric moment-magnetic moment-conductance coupling heating medium of the coating structure.

Fourthly, the ultrafine component particles that increase hysteresis loss, damping loss and domain wall resonance loss, and increase the wave absorption loss of the dense ultrafine particle aggregates, the ultrafine component particles that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss, the ultrafine component particles that increase the carriers such as free electrons, ions and doping defects and vacancies, an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate are fully mixed, sintered, crushed and classified, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of porous structure. For water-soluble ultrafine component particles that increase the hysteresis loss, damping loss and domain wall resonance loss and increase the wave absorption loss of the dense ultrafine particle aggregates, ultrafine component particles that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss, and ultrafine component particles that increase the carriers such as free electrons, ions and doping defects and vacancies, polymer chains can also be connected into a network using acrylamide free radical polymerization and a network agent by a polymer network gel method to obtain a gel, and then the obtained gel is sintered. Alternatively, for ultrafine component particles that increase the hysteresis loss, damping loss and domain wall resonance loss and increase the wave absorption loss of the dense ultrafine particle aggregates, ultrafine component particles that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss, and ultrafine component particles that increase the carriers such as free electrons, ions and doping defects and vacancies, that are insoluble in alcohol, a complexing agent can be added to the metal inorganic salt precursor solution and reacts with the metal ions by a metal complex gel method to form a soluble complex a complex salt to form a network gel, and then the obtained network gel is sintered to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the porous structure. Alternatively, by utilizing the ultrafine component ions that increase the hysteresis loss, damping loss and domain wall resonance loss, and increase the wave absorption loss of the dense ultrafine particle aggregates and the ultrafine component ions that increase the carriers such as free electrons, ions and doping defects and vacancies, and using appropriate precipitants, the high polarization loss dielectric porous ceramic is modified by a precipitation method, to form a composite film layer of the components that increase the hysteresis loss, damping loss and domain wall resonance loss and increase the wave absorption loss of the dense ultrafine particle aggregates and the components that increase the carriers such as free electrons, ions and doping defects and vacancies on the inner surface of the pores, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the porous structure. In addition, the pores of the high polarization loss dielectric porous ceramic can also be modified by a chemical plating method, and the component metal ions that increase the carriers such as free electrons, ions and doping defects and vacancies adsorbed in the plating solution in the pores are catalytically reduced to metals by the reducing agent in the plating solution and deposited on the inner surface of the pores to obtain the electric moment-electrical conductance coupling heating medium of the porous structure.

Fifthly, the electric moment-electrical conductance coupling heating medium particles of the core-shell structure obtained by the physical and chemical method in the first aspect, or the electric moment-magnetic moment coupling heating medium particles of the heterojunction structure obtained by the physical and chemical method in the second aspect, or the electric moment-electrical conductance coupling heating medium particles of the porous structure obtained by the physical and chemical method in the fourth aspect are mixed with inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and then a single-sided or double-sided film composite is performed on an aluminum sheet, a copper sheet or a stainless steel sheet by a spraying method or a brushing method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the film composite structure. Alternatively, aluminum sheets, copper sheets or stainless steel sheets are subjected to a single-sided or double-sided film composite using the components that increase hysteresis loss, damping loss and domain wall resonance loss and increase the wave absorption loss of dense ultrafine particle aggregates and the components that enhance the inherent electric moment orientation polarization and thermal ion relaxation polarization to cause high relaxation polarization loss by a chemical vapor deposition method, a gas phase pyrolysis method, a gas phase hydrolysis method, a phase combustion method, a flame vapor deposition method or a plasma spraying method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium of the film composite structure.

[0101] The first heating medium particles (0113) used in the first step are processed by a pulverization method and/or a synthesis method to a particle size distribution range of 0.1μm to 500μm, where the particle size distribution range of the particle heating medium directly blended with the gas-mist substrate is 15μm to 500μm; the particle size distribution range of the particle heating medium added to the manufactured slurry or roller-pressed paste of the tobacco sheet is 0.11μm to 100μm.

[0102] **Step 1-2,** the preparation of the foil-like film composite heating medium 1 (0114) used in the first aerosol generating system form (01) of the aerosol generating system and method using multi-caloric coupling giant caloric effect is as follows:

The ultrafine particles of the first heating medium prepared in step 1-1 are mixed with carboxymethyl cellulose, or guar gum or tobacco extract, and then the aluminum foil or copper foil is subjected to a single-sided or double-sided film composite by a casting method or a spraying method, and then cut to a size equivalent to that of tobacco sheets, and the particle size distribution range of the first heating medium particles is 15μm to 100μm; the aluminum foil or copper foil is subjected to a single-sided or double-sided film composite by a chemical vapor deposition method, a gas phase pyrolysis method, a gas phase hydrolysis method, a gas phase combustion method, or a flame vapor deposition method using the foil-like film composite heating medium 1, or the precursor of the first dielectric medium component and the first magnetic medium component, and then cut to obtain a size equivalent to that of tobacco sheets.

[0103] **Step 1-3,** the preparation of the aerosol generating substrate 1 (0112) used in the first aerosol generating system form (01) of the aerosol generating system and method using multi-caloric coupling giant caloric effect is as follows: The first heating medium particles (0113) prepared in step I-1 are directly blended with the gas-mist substrate, wherein the particle size distribution range of the first heating medium particles is 15μm to 500μm; or before the tobacco sheets in the gas-mist substrate are manufactured or roller-pressed, the first heating medium particles (0113) prepared in step 1-1 can be mixed into the fiber slurry or paste, so that the tobacco sheets are uniformly distributed with 5 to 60% by mass of the first heating medium particles (0113) prepared in step I-1, wherein the first heating medium particles have a particle size distribution range of 0.1μm to 100μm; or the electric moment-magnetic moment-electrical conductance coupling heating medium particles of the porous structure absorb the liquid phase components in the gas-mist substrate, and then are blended with other gas-mist substrate, wherein the particle size distribution range of the electric moment-magnetic moment-electrical conductance coupling heating medium particles of the porous structure is 15μm to 500μm; or the heating medium particles of the low excitation temperature aerosol generating substrate absorb the liquid phase components in the gas-mist substrate, and then blend with other gas-mist substrate, wherein the particle size distribution range of the heating medium particles of the low excitation temperature aerosol generating substrate is 15μm to 500μm. The foil-like film composite heating medium 1 (0114) can also be added to the aerosol generating substrate 1 (0112) in a blending mass ratio of 3 to 30%.

[0104] **Step 1-4,** the preparation of the curved electrode 1 (01321) and the curved electrode 2 (01322) of the tubular electrode plate (0132) used in the first aerosol generating system form (01) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect is as follows:
The tubular electrode plate (0132) is formed by compounding the curved electrode 1 (01321) and the curved electrode 2 (01322) on the inner surface of the tubular insulating ceramic substrate, wherein the curved electrode 1 and the curved electrode 2 are arranged in pieces and are opposite to each other, and the curved electrode 1 and the curved electrode 2 are both in 2 to 5 pieces. Preferably, the curved electrode 1 and the curved electrode 2 are both in 3 pieces, which are spaced and opposite to each other, and the adjacent curved electrodes 1 and 2 are separated by a gap insulating material (01323). The gap insulating material can be a tubular insulating ceramic substrate material, or a polyimide or aramid resin (poly(m-phenylene isophthalamide)), the insulating ceramic substrate material is Al_2O_3 ceramic, the gap between the curved electrode 1 and the curved electrode 2 is 0.5 to 2mm, preferably, the gap between the curved electrode 1 and the curved electrode 2 is 1mm, the curved electrode 1 and the curved electrode 2 are made of copper or silver, the height of the curved electrode 1 and the curved electrode 2 is equivalent to the aerosol generating section, the diameter of the tubular electrode plate is the diameter value of the aerosol generating section, and feeder connection positions (01324) and (01325) are provided at the lower end of each curved electrode 1 and curved electrode 2 corresponding to the tubular electrode plate (0132), and the curved electrode 1 and curved electrode 2 are connected to the heating drive unit of the aerosol generating system through the feeder.

[0105] **Step I-5,** the preparation of the first heating medium particle coating (0123) used in the first aerosol generating system form (01) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect is as follows:
The base material of the first heating medium particle coating (0123) is hexagonal boron carbon nitrogen ternary wave absorbing ceramic (h-BCN), the first heating medium particles are fully mixed with the film-forming agent sodium silicate sol, or aluminum dihydrogen phosphate sol, or aluminum hydroxide sol, or silica sol, and the mixture is coated to form a film, and sintered and cured at a high temperature above 800°C to form the first heating medium particle coating (0123). Alternatively, metal materials, such as aluminum, or copper or stainless steel sheets, which are used as the base, are coated with a mixed slurry of the particle heating medium (0112) prepared in the first step and an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and heat treated at 300°C to 450°C to form the preheating shell coating (0123). Alternatively, it can also be obtained by performing precipitation and heating on aluminum, copper or stainless steel sheets by a chemical vapor deposition method, a gas phase pyrolysis method, a gas phase hydrolysis method, a gas phase combustion method, a flame vapor deposition method, or a plasma spraying method.

[0106] **Step I-6,** the metal particle layer filter medium (0111) is formed by pressing aluminum particles with a size of 0.5 to 1.5mm and a thickness of about 0.2 to 1.2mm; the sealing ring (0131) is made of silicone rubber; the heating chamber a base disc (0133) is an insulating Al_2O_3 ceramic material. There are 8 to 36 through holes with a diameter of 0.3 to 2mm uniformly distributed on the disc; the temperature control unit (0134) passes through the central hole of the heating chamber a base and enters the aerosol generating section (011) for 2 to 5mm.

[0107] The materials and unit structures involved in the second aerosol generating system form (02) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect described in FIG. 7 and FIG. 8 of the present application include: an aerosol generating section 1 (021), a preheating shell (022), a heating chamber b (023), an electrode plate feeder (024), a power amplifier and control (025), an alternating electromagnetic field generator (026), a battery (027), a housing (028), a metal particle layer filter medium (0211), an aerosol generating substrate 1 (0212), a first heating medium particles (0213), a preheating shell air inlet (0221), a preheating shell substrate (0222), a first heating medium particle coating (0223), a sealing ring (0231), a planar electrode plate (0232), a heating chamber b base (0233), a temperature control unit (0234), a block heating medium 1 (0235), a planar electrode 1 (02321) and a planar electrode 2 (02322).

[0108] In the present application, the specific method for preparing the first heating medium particles (0213), the block heating medium 1 (0235), and the aerosol generating substrate 1 (0212) as well as the preparation basis and method of the planar electrode 1 (02321) and the planar electrode 2 (02322) and the first heating medium particle coating (0223), and the steps thereof involved in the second aerosol generating system form (02) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect shown in FIG. 7, and in the heating structure B of the aerosol generating system at the C-C section shown in FIG. 8 are as follows:

In the second aerosol generating system form (02) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect, the alternating electromagnetic field frequency range used by the heating drive unit is 0.3MHz to 300MHz, and the design principle of being compatible with and balancing the multi-caloric coupling frequency response range is: for dielectric medium components, enhancing the relaxation polarization loss of inherent electric moment orientation polarization and hot ion relaxation polarization; for magnetic medium components, increasing hysteresis loss and damping loss and domain wall resonance loss; for conductive medium components, increasing the electrical conductance loss of carriers such as free electrons and ions and the wave absorption loss of dense ultrafine particle aggregates.

[0109] **Step II-1,** the preparation of the first heating medium particles (0213) in the second aerosol generating system form is consistent with the preparation of the first heating medium particles (0113) used in the first aerosol generating system form (01), which will not be repeated here.

[0110] The first heating medium particles (0213) prepared in step II-1 are processed by a pulverization method and/or a synthesis method to a particle size distribution range of 0.1μm to 500μm, where the particle heating medium directly blended with the gas-mist substrate has a particle size distribution range of 15μm to 500μm; the particle size distribution range of the particle heating medium added to the manufactured slurry or roller-pressed paste of the tobacco sheet is 0.1μm to 100μm

[0111] **Step II-2,** the block heating medium 1 (0235) used in the second aerosol generating system form (02) of the aerosol generating system and method using multi-caloric coupling giant caloric effect is formed by mixing the first heating medium particles (0213) prepared in step II-2 with an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, pressing and calcining at a low temperature.

[0112] **Step II-3,** the first heating medium particles (0213) prepared in step II-1 are directly blended with the gas-mist substrate, wherein the particle size distribution range of the first heating medium particles is 15μm to 500μm; or before the tobacco sheets in the gas-mist substrate are manufactured or roller-pressed, the first heating medium particles (0213) prepared in the first step are mixed into the fiber slurry or paste, so that the tobacco sheets are uniformly distributed with 5 to 60% by mass of the first heating medium particles (0213) prepared in step II-1, wherein the particle size distribution range of the first heating medium particles is 0.1μm to 100μm; or the electric moment-magnetic moment-electrical conductance coupling heating medium particles of the porous structure adsorb the liquid phase components in the gas-mist substrate and then blend with other gas-mist substrate, wherein the particle size distribution range of the electric moment-magnetic moment-electrical conductance coupling heating medium particles of the porous structure is 15μm to 500μm; or the heating medium particles of the low excitation temperature aerosol generating substrate adsorb the liquid phase components in the gas-mist substrate and then blend with other gas-mist substrate, wherein the particle size distribution range of the heating medium particles of the low excitation temperature aerosol generating substrate is 15μm to 500μm. The foil-like film composite heating medium 1 (0214) can also be added to the aerosol generating substrate 1 (0212) in a mixing mass ratio of 3 to 30%.

[0113] **Step II-4,** the preparation of the planar electrode 1 (02321) and the planar electrode 2 (02322) of the planar electrode plate (0232) used in the second aerosol generating system form (02) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect is as follows:

The planar electrode plate (0232) is formed by compounding the planar electrode 1 (02321) and the planar electrode 2 (02322) on the surface of a planar insulating ceramic substrate, the material of the planar electrode 1 and the planar electrode 2 is copper or silver, and the insulating ceramic substrate material is Al_2O_3 ceramic.

[0114] **Step II-5,** the preparation of the first heating medium particle coating (0223) used in the second aerosol generating system form (02) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect is as follows:

The base material of the first heating medium particle coating (0223) is hexagonal boron carbon nitrogen ternary wave absorbing ceramic (h-BCN), the first heating medium particles are fully mixed with the film-forming agent sodium silicate sol, or aluminum dihydrogen phosphate sol, or aluminum hydroxide sol, or silica sol, and the mixture is coated to form a film, and sintered and solidified at a high temperature above 800°C to form the first heating medium particle coating (0223). Alternatively, metal materials, such as aluminum, or copper or stainless steel sheets, which are used as the base, are coated with a mixed slurry of the particle heating medium (0212) prepared in the first step and an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and heat treated at 300°C to 450°C to form the preheating shell coating (0223). Alternatively, it can also be obtained by performing precipitation and heating on aluminum, copper or stainless steel sheets by a chemical vapor deposition method, or a gas phase pyrolysis method, or a gas phase hydrolysis method, or a gas phase combustion method, or a flame vapor deposition method, or a plasma spraying method, or a plasma spraying method.

[0115] **Step II-6,** the metal particle layer filter medium (0211) is formed by pressing aluminum particles with a size of 0.5 to 1mm and a thickness of about 0.5 to 2mm; the sealing ring (0231) is made of silicone rubber; the heating chamber b base disc (0233) is an insulating Al_2O_3 ceramic material; the temperature control unit (0234) passes through the central hole of the heating chamber b base and enters the aerosol generating section (021) for 2 to 5mm.

[0116] The materials and unit structures involved in the third aerosol generating system form (03) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect described in FIG. 9, FIG. 10 and FIG. 11 of the present application include: an aerosol generating section 2 (031), a preheating shell (032), a heating chamber c (033), a PCB circuit board control (034), an alternating electromagnetic field generating source (035), a battery (036), a housing (037), and an aerosol generating substrate 2 (0312), second heating medium particles (0313), a preheating shell air inlet (0321), a preheating shell (0322), a second heating medium particle coating (0323), a metal particle layer filter medium (0331), a block heating medium 2 (0332), a temperature control unit (0333), a heating chamber c air inlet channel (0334), an air inlet seat hole of the heating chamber c (0335), an antenna (0336), an antenna feeder pin (0337) and a heating chamber c metal shielding shell (0338), a wave-transmitting ceramic tube (0339), a housing air inlet (0371).

[0117] In the present application, the specific method for preparing the second heating medium particles (0313), the block heating medium 2 (0332), and the aerosol generating substrate 2 (0312) as well as the preparation basis and method of the second heating medium particle coating (0323), and the steps thereof involved in the third aerosol generating system form (03) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect shown in FIG. 9, and in the heating structure C of the aerosol generating system at the C-C section shown in FIGs. 10 and 11 are as follows:
In the third aerosol generating system form (03) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect, the alternating electromagnetic field frequency range used by the heating drive unit is 0.3GHz to 30GHz, and the design principle of being compatible with and balancing the multi-caloric coupling frequency response range is: for dielectric medium components, enhancing the relaxation polarization loss of inherent electric moment orientation polarization and hot ion relaxation polarization and the resonant polarization loss of ion displacement polarization; for magnetic medium components, increasing hysteresis loss and damping loss, as well as the domain wall resonance, natural resonance, size resonance, and spin wave resonance in the resonance loss; for conductive medium components, increasing the electrical conductance loss of carriers such as free electrons and ions and the wave absorption loss of dense ultrafine particle aggregates.

[0118] **Step III-1,** the preparation of the second heating medium particles (0313) used in the third aerosol generating system form (03) of the aerosol generating system and method using multi-caloric coupling giant caloric effect is consistent with the preparation of the first heating medium particles (0113) used in the first aerosol generating system form (01), which will not be repeated here.

[0119] The second heating medium particles (0313) are processed by a pulverization method and/or a synthesis method to a particle size distribution range of 0.1μm to 500μm, where the particle size distribution range of the particle heating medium directly blended with the gas-mist substrate is 15μm to 500μm; the particle size distribution range of the particle heating medium added to the manufactured slurry or roller-pressed paste of the tobacco sheet is 0.1μm to 100μm.

[0120] **Step III-2,** in the third aerosol generating system form (03), the used block heating medium 2 (0332) is formed by mixing the second heating medium particles (0313) prepared in step III-1 with an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, pressing and calcining at a low temperature. The antenna (0336) is a PIFA planar inverted F antenna. Before calcining, the antenna (0336) is embedded in the block heating medium 2 corresponding to the lower portion of the air inlet seat hole of the heating chamber c (0335) and pressed into shape. The antenna feeder pin (0337) extends to the outside of the block heating medium 2 (0332). The air inlet seat hole of the heating chamber c (0335) communicates with the outside of the block heating medium 2 (0332) through 4 to 10 heating chamber c air inlet channels (0334) with a diameter of 0.5 to 2 mm. The heating chamber c metal shielding shell (0338) encloses the block heating medium 2 therein. The heating chamber c metal shielding shell (0338) is made of aluminum, copper or stainless steel.

[0121] In the third aerosol generating system form (03), a foil-like film composite heating medium 2 can also be added to the aerosol generating substrate 2. The second heating medium particles are mixed with the binder carboxymethyl cellulose, guar gum or tobacco extract, and then the aluminum foil or copper foil is subjected to a single-sided or double-sided film composite by a casting method or a spraying method, and then cut to a size equivalent to that of tobacco sheets. Alternatively, the foil-like film composite heating medium 2 is prepared by using the second dielectric component and the precursor of the second magnetic medium component by a chemical vapor deposition method, a gas phase pyrolysis method, a gas phase hydrolysis method, a gas phase combustion method, or a flame vapor deposition method.

[0122] **Step III-3,** preparation of the aerosol generating substrate 2 (0312) used in the third aerosol generating system form (03) is as follows:

The second heating medium particles (0313) prepared in step III-1 are directly blended with the gas-mist substrate, wherein the particle size distribution range of the second heating medium particles is 15μm to 500μm; the second heating medium particles (0313) prepared in step III-1 can also be mixed into the fiber slurry or paste before the tobacco sheet in the gas-mist substrate is manufactured or roller-pressed, so that the second heating medium particles (0313) prepared in step III-1 are uniformly distributed in the tobacco sheets at a mass ratio of 5 to 60%, wherein the particle size distribution range of the second heating medium particles is 0.1μm to 100μm; the foil-like film composite heating medium 2 (0314) can also be added to the aerosol generating substrate 2 (0312) in a mixing mass ratio of 3 to 30%.

[0123] The second heating medium particles (0313) can also be heating medium particles of a low excitation temperature aerosol generating substrate. The heating medium particles of the low excitation temperature aerosol generating substrate are prepared from a method comprising from the second heating medium particles (0313) prepared in step III-1, selecting particles with physical property parameters that meet the principle conditions of the Kelvin equation with a pore size ranging from 60nm to 50μm, a porosity ranging from 85% to 95%, a specific heat capacity ranging from 0.1 $kJ \cdot kg^{-1} \cdot K^{-1}$ to 0.6 $kJ \cdot kg^{-1} \cdot K^{-1}$, and a coefficient of thermal conductivity ranging from 0.035 $W \cdot m^{-1} \cdot K^{-1}$ to 0.125 $W \cdot m^{-1} \cdot K^{-1}$ to adsorb the liquid phase components of the aerosol generating medium, so that the liquid phase components are separated into small droplets entering the pores with a porosity of 85% to 95% and a pore size ranging from 60nm to 50μm, to increase the saturated vapor pressure value of the liquid phase component of the aerosol generating medium, and obtain the heating medium of the low excitation temperature aerosol generating substrate, wherein the excitation temperature is 160°C to 200°C, and the heating medium particles of the low excitation temperature aerosol generating substrate are blended with other gas-mist substrate, wherein the particle size distribution range of the heating medium particles of the low excitation temperature aerosol generating substrate is 15μm to 500μm.

[0124] **Step III-4,** the preparation of the second heating medium particle coating (0323) used in the third aerosol generating system form (03) is as follows:

The base material of the second heating medium particle coating (0323) is hexagonal boron carbon nitrogen ternary wave absorbing ceramic (h-BCN), the second heating medium particles are fully mixed with the film-forming agent sodium silicate sol, or aluminum dihydrogen phosphate sol, or aluminum hydroxide sol, or silica sol, and the mixture is coated to form a film, and sintered and solidified at a high temperature above 800°C to form the second heating medium particle coating (0323). Alternatively, metal materials, such as aluminum, or copper or stainless steel sheets, which are used as the base, are coated with a mixed slurry of the particle heating medium (0313) prepared in the first step and an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and heat treated at 300°C to 450°C to form the preheating shell coating (0323). Alternatively, it can also be obtained by performing precipitation and heating on aluminum, copper or stainless steel sheets by a chemical vapor deposition method, a gas phase pyrolysis method, a gas phase hydrolysis method, a gas phase combustion method, a flame vapor deposition method, or a plasma spraying method.

[0125] **Step III-5,** the metal particle layer filter medium (0331) is formed by pressing aluminum particles with a size of 0.5 to 1.5mm and a thickness of about 0.2 to 1.2mm; the wave-transmitting ceramic tube (0339) is quartz ceramic SiO_2 or high alumina ceramic Al_2O_3 or Si_3N_4 ceramic material; the temperature control unit (0333) is transversely placed on the inner surface of the wave-transmitting ceramic tube (0339) at a position of 2 to 3mm away from the free port of the aerosol generating section (031).

[0126] In order to further illustrate the present application, the aerosol generating system using a multi-caloric coupling giant caloric effect and the heating medium provided by the present application are described in detail below in conjunction with examples, but they should not be understood as limiting the scope of protection of the present application.

Example 1

[0127] The preparation of the first aerosol generating system form (01) of the aerosol generating system using the multi-caloric coupling giant caloric effect and the first heating medium (0113) of the present application:

1-i) The first heating medium includes a first dielectric medium, a first magnetic medium and a first conductive medium, and the composition thereof is as follows:

The first magnetic medium component is Fe_3O_4; the first conductive medium component is ZnO. The first heating medium of the Fe_3O_4@ZnO of the core-shell structure is prepared by a direct precipitation method. The specific steps are as follows:

Step 1: 500ml zinc acetate dihydrate and 50g ascorbic acid granular raw materials were added to a stirred reactor, and deionized water was added.

Step 2: After the granular raw materials in step 1 were completely dissolved, 40g Fe_3O_4 granular raw materials was added to the solution, and stirred at high speed. After the particles were uniformly dispersed to form a mixed suspension, 200 ml hexamethylenetetramine (HMTA) precipitant was added to the mixed suspension, and the mixture was continued to be stirred at a high speed, wherein the Fe_3O_4 particles have a size between 500nm and 1μm.

Step 3: The stirred reactor was heated, the temperature was slowly raised to 90°C and kept for 3h, and the speed was maintained at 800rpm.

Step 4: The product Fe_3O_4@ZnO after the reaction was centrifuged at 7500rpm for 2min, washed with 500ml of ionized water and 500ml of anhydrous ethanol respectively, and then placed in a constant temperature drying oven at 80°C for 12h to prepare a core-shell structure powder product with Fe_3O_4 as the core and ZnO as the shell, where the thickness of the ZnO shell was between 100nm and 300nm.

Step 5: 30g of Fe_3O_4@ZnO core-shell structure powder product was compacted into a green body, placed in a high-temperature furnace, sintered at 1000°C for 3h, cooled, crushed, and classified to a particle size distribution range of 0.1μm to 500μm to obtain the first heating medium (0113) of the core-shell structure. Reference is made to Figure 12.

[0128] 1-ii) The preparation of other heating medium based on the first heating medium (0113) is as follows:

(1) The first heating medium was classified to a particle size distribution range of 1μm to 200μm, and mixed with sodium silicate sol in an amount of 35wt% to form a slurry, and the slurry was sprayed on a copper sheet in a thickness of 0.8mm, which was then heat treated at 420°C to form a first heating medium particle coating (0123).

(2) The first heating medium was classified to a particle size distribution range of 15μm to 100μm, and mixed with carboxymethyl cellulose solution in an amount of 40wt% to form a slurry, and the slurry was sprayed on aluminum foil on both sides, which was then dried at 80°C to form a foil-like film composite heating medium 1 (0114).

(3) The first heating medium was classified to a particle size distribution range of 0.1μm to 100μm, and was used as a particle heating medium for the tobacco sheet manufactured slurry mixed in the aerosol generating substrate 1 (0112), wherein the first heating medium was mixed in a mass ratio of 30%.

[0129] 1-iii) The related structure of the first aerosol generating system form (01) of the aerosol generating system using multi-caloric coupling giant caloric effect is as follows:

(1) The preparation of the curved electrode 1 (01321) and the curved electrode 2 (01322) of the tubular electrode plate (0132) involved in the first aerosol generating system form (01) of the aerosol generating system and method using multi-caloric coupling giant caloric effect is as follows:
The tubular electrode plate (0132) was formed by compounding the curved electrode 1 (01321) and the curved electrode 2 (01322) on the inner surface of the tubular insulating ceramic substrate, wherein the curved electrode 1 and the curved electrode 2 were arranged in pieces and were opposite to each other, the curved electrode 1 and the curved electrode 2 were both in 3 pieces, and were spaced and opposite to each other, and the adjacent curved electrodes 1 and curved electrodes 2 were separated by a gap insulating material (01323), wherein the gap insulating material was a polyimide or aramid resin (poly(m-phenylene isophthalamide)), the insulating ceramic substrate material was Al_2O_3 ceramic, the gap between the curved electrode 1 and the curved electrode 2 was 1mm, the curved electrode 1 and the curved electrode 2 were made of 1mm copper sheet, the height of the curved electrode 1 and the curved electrode 2 was 14mm, the diameter of the tubular electrode plate was 7.5mm, and feeder connection positions (01324) and (01325) were provided at the lower end of each curved electrode 1 and curved electrode 2 corresponding to the tubular electrode plate (0132), and the curved electrode 1 and curved electrode 2 were connected to the heating drive unit of the aerosol generating system through the feeder.

(2) The metal particle layer filter medium (0111) was formed by pressing aluminum particles with a size of 1mm and a thickness of about 0.6mm; the sealing ring (0131) was made of silicone rubber; the heating chamber a base disc (0133) was made of insulating Al_2O_3 ceramic material. There were 12 through holes with a diameter of 0.6 mm uniformly distributed on the disc; the temperature control unit (0134) passed through the central hole of the heating chamber a base and entered the aerosol generating section (011) for 3 mm.

(3) The aerosol generating section was mainly composed of an aerosol generating substrate 1 (0112) and a foil-like film composite heating medium 1 (0114), where the content of the aerosol generating substrate 1 was 92wt%, and the content of the foil-like film composite heating medium 1 was 8wt%; the aerosol generating substrate 1 was composed of the added first heating medium and the gas-mist substrate containing tobacco sheets, where the gas-mist substrate was composed of natural tobacco, or artificial homogenized tobacco plant materials such as reconstituted tobacco

shreds and tobacco sheets, and tobacco extracts, flavors, and liquid phase aerosols such as polyols or polyol esters; the first heating medium can be blended with the gas-mist substrate, or added as a particle filler to the first heating medium during the manufacturing process of the tobacco sheets contained in the gas-mist substrate to form the aerosol generating substrate 1, where the mass ratio of the first heating medium in the aerosol generating substrate 1 was 20%; the tobacco sheets were mainly composed of tobacco dust, tobacco leaves and tobacco stem fibers, added with carboxymethyl cellulose or natural adhesives such as pectin and gum and other additives; the composition of the usual tobacco sheets was well known in the art.
The mass ratio of the components in the gas-mist substrate: tobacco sheets 45%, first heating medium 20%, tobacco extract 15%, glycerol 17%, carboxymethyl cellulose 2%, tobacco flavoring agent 1%.

(4) In the first aerosol generating system form (01) of the aerosol generating system using the multi-caloric coupling giant caloric effect, it took about 20 seconds for the aerosol generating section to be heated from 30°C to 250°C when driven by an alternating electromagnetic field with a frequency of 27.12 MHz.

Example 2

[0130] The preparation of the second aerosol generating system form (02) of the aerosol generating system using the multi-caloric coupling giant caloric effect and the first heating medium (0213) of the present application:
2-i) The first heating medium includes a first dielectric medium, a first magnetic medium and a first conductive medium, and the composition thereof is as follows:
The first dielectric medium component is Bi, Te; the first magnetic medium component is La, Mn; the first conductive medium is Mn. The first heating medium of $Bi_2Te_3@Mn_{15}Bi_{34}Te_{51}@La_{15}Bi_{34}Te_{51}$ of the heterojunction structure is prepared by mechanical alloying method. The specific steps are as follows:

Step 1: High-purity elements Bi, Te and pure La, Mn were added into an intermittent ball mill according to the atomic percentage of Bi_2Te_3, $Mn_{15}Bi_{34}Te_{51}$ and $La_{15}Bi_{34}Te_{51}$ respectively.

Step 2: The vacuum degree of the ball mill was evacuated to 10^{-3}Pa and then high-purity argon gas was introduced, wherein the ball-to-material ratio was 15:1, and the rotation speed was 150r/min.

Step 3: Through the long-term intense impact and collision between the raw material particles and the grinding balls, the particles were repeatedly cold welded and broken; during the long ball milling time, atoms can diffuse in the system to obtain a uniform heterojunction structure heating medium, wherein the mass ratio of Bi_2Te_3, $Mn_{15}Bi_{34}Te_{51}$ and $La_{15}Bi_{34}Te_{51}$ was 4.5:3:2.5, and the particle size was between 15μm and 100μm;.

Step 4: the heterojunction powder composed of 20g Bi_2Te_3, 50g $Mn_{15}Bi_{34}Te_{51}$ and 30g $La_{15}Bi_{34}Te_{51}$ was made into a circular blank, placed in a high-temperature furnace, and sintered at 800°C for 5h, and crushed and classified to a particle size distribution range of 0.1μm to 500μm, to obtain the first heating medium (0213) of the heterojunction structure; reference is made to Figure 13.

[0131] 2-ii) Preparation of other heating medium based on the first heating medium (0213) is as follows:

(1) The first heating medium was classified to a particle size distribution range of 1μm to 200μm, and mixed with aluminum dihydrogen phosphate sol in an amount of 40wt% to form a slurry, and the slurry was coated on the inner wall of the preheating shell substrate (0222) hexagonal boron carbon nitrogen ternary wave absorbing ceramic (h-BCN), which was cured at 820°C to form the first heating medium particle coating (0223).

(2) In the first heating medium (with a particle size distribution range of 0.1μm to 500μm), 8wt% of aluminum dihydrogen phosphate sol was added, and the mixture was mixed uniformly, pressed into shape, and cured at 820°C to form the block heating medium 1 (0235);.

(3) The first heating medium was classified to a particle size distribution range of 15μm to 500μm, and was used as the particle heating medium directly blended with the gas-mist substrate in the aerosol generating substrate 1 (0212).

(4) The first heating medium was classified to a particle size distribution range of 0.1μm to 100μm, and mixed uniformly with aluminum dihydrogen phosphate sol and starch dextrin in a mass ratio of first heating medium: aluminum dihydrogen phosphate sol: starch dextrin = 9:0.4:0.6; the mixture was lightly pressed into a green body, sintered at 1000°C, and crushed and classified to obtain porous particles with a particle size distribution range of 15μm

to 500μm, a pore size of 8nm to 35μm, and a porosity of 78% to 90%; after adsorbing the liquid phase component in the gas-mist substrate, the liquid absorption mass ratio was approximately: porous particles: liquid phase component = 1:1.2, to obtain the heating medium particles of the low excitation temperature aerosol generating substrate.

[0132] 2-iii) The related structure of the second aerosol generating system form (02) of the aerosol generating system using multi-caloric coupling giant caloric effect is as follows:

(1) The preparation of the planar electrode 1 (02321) and the planar electrode 2 (02322) of the planar electrode plate (0232) involved in the second aerosol generating system form (02) of the aerosol generating system and method using multi-caloric coupling giant caloric effect is as follows:
The planar electrode plate (0232) was formed by compounding the planar electrode 1 (02321) and the planar electrode 2 (02322) on the surface of a planar insulating ceramic substrate, the curved electrode 1 and the curved electrode 2 were arranged in pieces and were opposite to each other with a spacing of the diameter of the aerosol generating section, 7.5mm; a block heating medium 1 (0235) was sandwiched between each of two pairs of corresponding ends of the planar electrode plate 1 and the planar electrode plate 2; a cylindrical hole was arranged at the symmetrical center of the two sandwiched block heating medium 1, and the diameter of the cylindrical hole was the diameter of the aerosol generating section, 7.5mm, and the length of the cylindrical hole was the length of the aerosol generating section, about 14mm; the material of the planar electrode 1 and the planar electrode 2 was a copper sheet with a thickness of 0.5mm, and the insulating ceramic substrate material was Al_2O_3 ceramic; and the planar electrode 1 and the planar electrode 2 were connected to the heating drive unit of the aerosol generating system through a feeder.

(2) The metal particle layer filter medium (0211) was formed by pressing aluminum particles with a size of 1mm and a thickness of about 0.6mm; the sealing ring (0231) was made of silicone rubber; the heating chamber b base disc (0233) was made of insulating Al_2O_3 ceramic material; the temperature control unit (0234) passed through the central hole of the heating chamber b base and entered the aerosol generating section (021) for 3mm.

(3) The aerosol generating substrate 1 was mainly formed by blending the gas-mist substrate with the first heating medium and the heating medium of the low excitation temperature aerosol generating substrate, where the gas-mist substrate was in 50wt% (the composition of the components was the same as that of Example 1), the first heating medium was in 20wt%, and the heating medium of the low excitation temperature aerosol generating substrate was in 30wt%;.

(4) In the second aerosol generating system form (02) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect, it took about 17 seconds for the aerosol generating section to be heated from 30 °C to 250 °C when driven by an alternating electromagnetic field with a frequency of 40.68 MHz.

Example 3

[0133] The preparation of the third aerosol generating system form (03) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect and the second heating medium (0313) of the present application:
3-i) The second heating medium includes a second dielectric medium, a second magnetic medium and a second conductive medium, and the composition thereof is as follows:
The second dielectric medium is a $BaO\text{-}MgO\text{-}Ta_2O_5$ system; the second magnetic medium is a Co_2Z (Z-type hexagonal ferrite) system; the second conductive medium is CoO and Fe_2O_3. The second heating medium of the $BaO\text{-}MgO\text{-}Ta_2O_5/Co_2Z$ of the coating structure is prepared by a solid phase method. The specific steps are as follows:

Step 1: 200g $BaCO_3$ particles, 40g MgO particles, and 440g Ta_2O_5 particles were mixed, and reacted at a high temperature of 1200 °C for 24h to obtain $BaO\text{-}MgO\text{-}Ta_2O_5$ particles.

Step 2: 178g $BaCO_3$ particles, 48g Co_3O_4 particles, and 550g Fe_2O_3 particles were mixed, and reacted at a high temperature of 1280 °C for 6h to obtain $Ba_3Co_2Fe_{23}O_{41}$ (Co_2Z) particles.

Step 3: 30g $BaO\text{-}MgO\text{-}Ta_2O_5$ particles were mixed with 45g Co_2Z particles, and reacted at a high temperature of 1100 °C for 24h to obtain $BaTiO_3$/NiZnFe composite particles.

Step 5: 30g $BaO\text{-}MgO\text{-}Ta_2O_5/Co_2Z$ composite structure coupled heating medium was made into a circular blank, placed in a high temperature furnace, sintered at 1200°C for 6h, crushed and classified to a particle size distribution range of 0. 1μm to 500μm to obtain the second heating medium (0313) of the coating structure, reference is made to Figure 14.

[0134] 3-ii) Preparation of other heating media based on the second heating medium (0313) is as follows:

(1) The second heating medium was classified to a particle size distribution range of 1μm to 200μm, and mixed with aluminum hydroxide sol in an amount of 36wt% to form a slurry, and the slurry was coated on the inner wall of the preheating shell substrate (0322) hexagonal boron carbon nitrogen ternary wave absorbing ceramic (h-BCN), which was cured at 900°C to form the second heating medium particle coating (0323).

(2) 10wt% aluminum dihydrogen phosphate sol was added to the second heating medium (with a particle size distribution range of 0.1μm to 500μm), and the mixture was mixed uniformly, pressed into shape, and calcined and solidified at 820°C to form the block heating medium 2 (0332);.

(3) The second heating medium was classified to a particle size distribution range of 0.1μm to 100μm, and was used as the particle heating medium for the tobacco sheet fiber paste mixed in the aerosol generating substrate 2 (0312), wherein the second heating medium was mixed in a mass ratio of 30%.

[0135] 3-iii) The related structure of the third aerosol generating system form (03) of the aerosol generating system using the multi-caloric coupling giant caloric effect is as follows:

(1) The preheating shell (032) was provided with a metal shielding shell (0338), a block heating medium 2 (0332) and an antenna (0336) embedded in the block heating medium 2, where the antenna was a PIFA planar inverted F antenna; the metal shielding shell was wrapped around the outside of the block heating medium 2, and the metal shielding shell was made of stainless steel sheet with a thickness of 0.2 mm.
The metal shielding shell, the block heating medium 2 and the antenna embedded in the block heating medium 2 formed a heating chamber, and the air inlet seat hole of the heating chamber communicated with the outside of the block heating medium 2 through 6 air inlet channels with a diameter of 0.6 mm.

(2) The block heating medium 2 was a cube; a cylindrical hole was provided on the symmetry axis of the block heating medium 2, and an aerosol generating section was formed inside the hole; a wave-transmitting ceramic tube was nested in the cylindrical hole, and the inner diameter of the wave-transmitting ceramic tube was the diameter of the aerosol generating section, 7.4 mm, and the depth was 14 mm, and the material was a high-alumina Al_2O_3 wave-transmitting ceramic; the temperature control unit was transversely placed on the inner surface of the wave-transmitting ceramic tube at a position of 2 mm away from the free port of the aerosol generating section.

(3) The aerosol generating substrate 2 was mainly formed by a gas-mist substrate and the second heating medium particles mixed in a tobacco sheet fiber paste, wherein the particle size distribution range of the second heating medium particles was 0.1 μm to 100 μm, the addition amount of the second heating medium particles was 30wt%, and the remaining 70wt% was a gas-mist substrate (the composition of the components was the same as that of Example 1).

(4) In the third aerosol generating system form (03) of the aerosol generating system and method using multi-caloric coupling giant caloric effect, it took about 13 seconds for the aerosol generating section to be heated from 30 °C to 250 °C when driven by an alternating electromagnetic field with a frequency of 2.45 GHz.

Example 4

[0136] The second heating medium of the coating structure was prepared by a sol-gel method, including the steps as follows:

Step 1: 50 g of Fe_3O_4 raw material particles were added to a reactor containing 300 ml of ethylene glycol and stirred and dispersed at a high speed, where the Fe_3O_4 particle size was between 100 nanometers and 500 nanometers.

Step 2: Deionized water and 25% ammonia water were added, with 10 liters of 25% ammonia water per kilogram of Fe_3O_4, and then 0.5 liters of tetraethyl orthosilicate were added, and the mixture was stirred at a constant speed for 10 hours.

Step 3: After the reaction was completed, the obtained particles were separated by an electromagnet and washed several times with 500 ml of ethanol and 500 ml of deionized water.

Step 4: Finally, the obtained particles were dried at 60°C for 12 hours to prepare a coating structure coupled heating medium with Fe_3O_4 as the mother particle and SiO_2 as the sub-particle.

Step 5: 30 g of Fe_3O_4@SiO_2 coating structure heating medium was made into a circular blank, placed in a high temperature furnace, and sintered at 900°C for 5 hours (referring to Fig. 15), and crushed and classified to obtain a finished product as the second heating medium of the coating structure with a response frequency ranging from 0.3 GHz to 30 GHz.

Step 6: In the third aerosol generating system form (03) of the aerosol generating system and method using multi-caloric coupling giant caloric effect with a frequency of 2.45 GHz, the sample of step 5 was heated, and it took about 19 seconds to heat the sample from 30°C to 250°C.

Example 5

[0137] The first heating medium of the porous structure was prepared by the polymer network gel method, including steps as follows:

Step 1: 1 mol/L triammonium citrate solution was prepared, 500 ml tetrabutyl titanate was added to 300 ml of triammonium citrate according to the ratio of n(triammonium citrate): n(Ti)=1:1 and stirred, and then 50 g of ferric nitrate was added to the mixed solution according to n(Fe): n(Ti)=0; 0.5%; 1.0%; 1.5% and 2.0%, and the pH value was adjusted to 8.5 with ammonia water.

Step 2: After fully mixing, 30 g of organic monomer N-hydroxymethyl acrylamide, 6 g of cross-linking agent N,N'-methylenebisacrylamide, 1 g of initiator ammonium persulfate and 1 g of catalyst tetramethylethylenediamine were added to each liter of the solution, and stirred uniformly, and a polymer network gel was formed after 5-15 minutes.

Step 3: The polymer network gel was dried in an oven at 80°C for 48 hours.

Step 4: 300g of dry gel was placed in a calcining furnace and calcined at a certain temperature for 2 hours to obtain an iron-doped TiO_2 porous structure coupled heating medium, where the pore size was between 100 and 500 nanometers.

Step 5: 30 g of the iron-doped TiO_2 porous structure coupled heating medium was made into a circular blank, placed in a high-temperature furnace, and sintered at 800°C for 5 hours to obtain a finished product (referring to Fig. 16), as the first heating medium of the porous structure with a frequency range of 0.3MHz to 300MHz.

Step 6: In the first aerosol generating system form (01) of the aerosol generating system and method using the multi-caloric coupling giant caloric effect with a frequency of 13.56 MHz, the sample in step 5 was heated, and it took about 21 seconds to heat the sample from 30°C to 250°C.

Example 6

[0138] The first heating medium of the film composite structure was prepared by chemical vapor deposition, including steps as follows:

Step 1: Aluminum foil of a certain size was selected as the substrate material. Alcohol and acetone were used to ultrasonically remove stains on the surface of the aluminum foil, and then the aluminum foil was washed with pickling liquid to remove the oxide layer on the surface;

Step 2: 100g $Nd_{13.5}(FeZrCo)_{80.5}B_6$ magnetic powder and 150g $Fe(CO)_3$ were put into the reactor and evaporator respectively, which were sealed, so that the evaporated $Fe(CO)_3$ was mixed with argon gas and passed into the reactor for chemical vapor deposition, wherein the reactor was continuously vibrated to ensure the uniformity of the coating;

Step 3: After the reaction was completed, the reactor was cooled to room temperature to obtain $Nd_{13.5}$(FeZr-

$Co)_{80.5}B_6$-$Fe(CO)_3$ film composite structure coupled heating medium (referring to FIG. 17), wherein the thickness of the composite film was between 100μm and 500μm, as the first heating medium of the film composite structure with a frequency range of 0.3MHz to 300MHz.

Step 4: In the second aerosol generating system form (02) of the aerosol generating system and method using multi-caloric coupling giant caloric effect at a frequency of 27. 12MHz, the sample of step 3 was heated, and it took about 16 seconds to heat the sample from 30°C to 250°C.

Example 7

[0139] The second heating medium of the coating structure was prepared by a solid phase method, including steps as follows:

Step 1: 200g $BaCO_3$ particles and 80g TiO_2 particles were mixed in a molar ratio of 1:1, and then reacted at a high temperature of 1500°C for 24h to obtain $BaTiO_3$ particles.

Step 2: 22g NiO particles, 57g ZnO particles, and 160g Fe_2O_3 particles were mixed, and then reacted at a high temperature of 1250°C for 4h to obtain $Ni_{0.3}Zn_{0.7}Fe_2O_4$ particles.

Step 3: 10g $BaTiO_3$ particles were mixed with 20g $Ni_{0.3}Zn_{0.7}Fe_2O_4$ particles, and then reacted at a high temperature of 1150°C for 5h to obtain $BaTiO_3/Ni_{0.3}Zn_{0.7}Fe_2O_4$ composite particles.

Step 4: 30g $BaTiO_3/Ni_{0.3}Zn_{0.7}Fe_2O_4$ composite structure coupled heating medium was made into a circular blank, placed in a high-temperature furnace, sintered at 1100°C for 5h (referring to FIG. 18), and crushed and classified to obtain a finished product, as the second heating medium of the coating structure with a frequency range of 0.3GHz to 30GHz.

Step 5: In the third aerosol generating system form (03) of the aerosol generating system and method using multi-caloric coupling giant caloric effect with a frequency of 2.45 GHz, the sample of step 5 was heated, and it took about 18 seconds to heat the sample from 30°C to 250°C.

Example 8

[0140] The second heating medium of the coating structure was prepared by high-temperature solid phase method and sol-gel method, including steps as follows:

Step 1: 140g K_2CO_3 particles were mixed with 265g Nb_2O_5 particles, and then reacted at a high temperature of 1200 °C for 14h to obtain $KNbO_3$ particles.

Step 2: 50g of ferric nitrate, 30g of manganese nitrate, and 25g of zinc nitrate were used as source materials, 500ml of citric acid was used as chelating agent, and 300ml of ethylene glycol was used as thickener, and ammonia water was used to adjust the pH value to >13.0, the mixed solution was refluxed at 70°C, and evaporated at 90°C to obtain a sol, and the sol was dried to obtain a dry gel, and then calcined to obtain sol-gel $Mn_{0.5}Zn_{0.5}Fe_2O_4$ powder.

Step 3: 10g of $KNbO_3$ particles were mixed with 25g of $Mn_{0.5}Zn_{0.5}Fe_2O_4$ particles, and then reacted at a high temperature of 1150°C for 5h to obtain $KNbO_3/Mn_{0.5}Zn_{0.5}Fe_2O_4$ composite particles.

Step 4: 30 g of $KNbO_3/Mn_{0.5}Zn_{0.5}Fe_2O_4$ composite structure coupled heating medium was made into a circular blank, placed in a high temperature furnace, sintered at 1100°C for 5 hours (referring to FIG. 19), and then crushed and classified to obtain a finished product, as the second heating medium of the coating structure with a frequency range of 0.3 GHz to 30 GHz.

Step 5: In the third aerosol generating system form (03) of the aerosol generating system and method using multi-caloric coupling giant caloric effect with a frequency of 2.45 GHz, the sample of step 5 was heated, and it took about 20 seconds to heat the sample from 30°C to 250°C.

Example 9

[0141] The second heating medium of the coating structure was prepared by a solid phase method, including steps as follows:

Step 1: 200 g of $BaCO_3$ particles, 40 g of MgO particles, and 440 g of Ta_2O_5 particles were mixed, and then reacted at a high temperature of 1200°C for 24 hours to obtain BaO-MgO-Ta_2O_5 particles.

Step 2: 50 g of BaO-MgO-Ta_2O_5 particles were mixed with 30 g of NiO particles, and then reacted at a high temperature of 900 °C for 10 h to obtain BaO-MgO-Ta_2O_5/NiO composite particles.

Step 3: 25 g of BaO-MgO-Ta_2O_5/NiO composite structure coupled heating medium was made into a circular blank, placed in a high-temperature furnace, sintered at 1100 °C for 5 h (referring to FIG. 20), crushed and classified to obtain a finished product, as the second heating medium of the coating structure with a frequency range of 0.3 GHz to 30 GHz.

Step 4: In the third aerosol generating system form (03) of the aerosol generating system and method using multi-caloric coupling giant caloric effect with a frequency of 2.45 GHz, the sample of step 4 was heated, and it took about 18 seconds to heat the sample from 30 °C to 250 °C.

Example 10

[0142] The second heating medium of the coating structure was prepared by a solid phase method, including steps as follows:

Step 1: After 178g $BaCO_3$ particles, 48g Co_3O_4 particles, and 550g Fe_2O_3 particles were mixed, and reacted at a high temperature of 1280 °C for 6h to obtain $Ba_3Co_2Fe_{23}O_{41}$ (Co_2Z) particles.

Step 2: 50g Co_2Z particles and 30g ZnO particles were mixed, and reacted at a high temperature of 1100 °C for 14h to obtain Co_2Z/ZnO particles.

Step 3: 30g Co_2Z/ZnO composite structure coupled heating medium was made into a circular blank, placed in a high temperature furnace, and sintered at 1100°C for 5h (referring to FIG. 21), and crushed and classified to obtain a finished product as the second heating medium of the coating structure with a frequency range of 0.3GHz to 30GHz.

Step 4: In the third aerosol generating system form (03) of the aerosol generating system and method using multi-caloric coupling giant caloric effect at a frequency of 2.45 GHz, the sample in step 4 was heated, and it took about 17 seconds to heat the sample from 30 °C to 250 °C.

[0143] It can be seen from the above examples, in the aerosol generating system using the multi-caloric coupling giant caloric effect provided according to the present application, (1) regarding the dielectric medium component of the heating medium, measures are taken to strengthen the inherent electric moment orientation polarization, the thermal ion relaxation polarization and the ion displacement polarization, so as to optimize the utilization of the relaxation polarization loss and the resonance polarization loss, and obtain a high polarization loss dielectric medium; regarding the magnetic medium component of the heating medium, measures are taken to strengthen the hysteresis loss, the damping loss and the resonance loss, so as to obtain a high hysteresis loss magnetic medium; regarding the conductive medium component of the heating medium, measures are taken to increase the free electrons, ions and the doping defects and vacancies, so as to optimize the utilization of the electrical conductance loss of various carriers, and obtain a conductive medium with high electrical conductance loss; (2) regarding the material structure of the heating medium, the dielectric medium, the magnetic medium and the conductive medium are compositely constructed by a physical and chemical method of multi-phase components to form a core-shell structure, or a heterojunction structure, or a coating structure, or a porous structure or a film composite structure, so as to realize the composite at the mesoscopic scale, so as to facilitate the multi-field coupling to generate the multi-caloric coupling giant caloric effect; (3) regarding lowering the thermal excitation temperature of the aerosol generating substrate, the heating medium of the porous structure adsorbs the liquid phase components of the aerosol generating medium, so that the liquid phase components are differentiated into a large number of small droplets; (4) regarding the heating drive unit of the aerosol generating system, the used frequency of the alternating electromagnetic field is a balanced compatible response frequency that meets the requirements of multi-caloric coupling of electric caloric, magnetic caloric and conductive caloric for multi-field coupling drive, and the compatible response frequency range is 0.3MHz to 30GHz.

[0144] The above is only a preferred embodiment of the present application. It should be pointed out that for ordinary technicians in this technical field, without departing from the principle of the present application, several improvements and modifications can be made, and these improvements and modifications should also be regarded as the protection scope of the present application.

Claims

1. An aerosol generating substrate comprising a heating medium, wherein the heating medium comprises a first heating medium or a second heating medium;

    the first heating medium comprises a first dielectric medium, a first magnetic medium and a first conductive medium;
    the first dielectric medium is selected from at least one of following systems:

        (1) perovskite structure system, comprising $BaTiO_3$, and/or $PbTiO_3$, and/or $NaNbO_3$, and/or $KNbO_3$, and/or $BiFeO_3$; (2) tungsten bronze structure system, comprising lead metaniobate, and/or $Sr_{1-x}Ba_xNb_2O_6$; (3) bismuth layered structure system, comprising $SrBi_2Ta_2O_9$, and/or $Bi_4Ti_3O_{12}$, and/or $SrBi_4Ti_4O_{15}$; (4) pyrochlore structure system, comprising $Cd_2Nb_2O_7$, and/or $Pb_2Nb_2O_7$;
        the first magnetic medium is selected from at least one of following ferrites:

            spinel ferrites, comprising MFe_2O_4, M = Mn, and/or Fe, and/or Ni, and/or Co, and/or Cu, and/or Mg, and/or Zn, and/or Li, and/or MnZn, and/or NiZn, and/or MgZn, and/or LiZn ferrite; and/or $R_3Fe_5O_{12}$, R is a rare earth element, and the rare earth element is Y, and/or La, and/or Pr, and/or Nd, and/or Sm, and/or Eu, and/or Gd, and/or Tb, and/or Dy, and/or Ho, and/or Er, and/or Tm, and/or Yb, and/or Lu;
            the first conductive medium is selected from at least one of following components:

                ZnO series, comprising those doped with Al (AZO), and/or doped with In (IZO), and/or doped with Ga (GZO); magnetic oxides, comprising CoO, and/or MnO, and/or Fe_3O_4, and/or NiO; and other semiconductor oxides, comprising Ga_2O_3, and/or In_2O_3, and/or InSnO (ITO);
                the second heating medium comprises a second dielectric medium, a second magnetic medium and a second conductive medium;
                the second dielectric medium is selected from (1) BaO-MgO-Ta_2O_5, and/or BaO-ZnO-Ta_2O_5, and/or BaO-MgO-Nb_2O_5, and/or BaO-ZnO-Nb_2O_5 systems and composite systems thereof; (2) $BaTi_4O_9$, and/or $BaTi_9O_{20}$, (Zr, and/or Sn)TiO_4-based systems; (3) BaO-Ln_2O_3-TiO_2, and/or CaO-Li_2O-Ln_2O_3-TiO_2 (in which Ln_2O_3 is a lanthanide rare earth oxide) based system; (4) $A_5B_4O_{15}$ (A=Ba, and/or Sr, and/or Mg, and/or Zn, and/or Ca, B=Nb, and/or Ta), and/or AB_2O_6 (A=Ca, and/or Co, and/or Mn, and/or Ni, and/or Zn; B=Nb, and/or Ta); $(Ba_{1-x}M_x)ZnO_5$ (M=Ca, and/or Sr, x=0 to 1.0), $AgNb_{1-x}Ta_xO_3$ (x=0 to 1.0), and/or $LnAlO_3$ (Ln=La, and/or Nd, and/or Sm), and/or Ta_2O_5-ZrO_2, and/or $ZnTiO_3$, and/or $BiNbO_4$ series;
                the second magnetic medium is selected from M-type hexagonal ferrite: BaM, and/or PbM, and/or SrM; X-type hexagonal ferrite, comprising Fe_2X; W-type hexagonal ferrite, comprising Mg_2W, and/or Mn_2W, and/or Fe_2W, and/or Co_2W, and/or Ni_2W, and/or Cu_2W, and/or Zn_2W; Y-type hexagonal ferrite, comprising Mg_2Y, and/or Mn_2Y, and/or Fe_2Y, and/or Co_2Y, and/or Ni_2Y, and/or Cu_2Y, and/or Zn_2Y; Z-type hexagonal ferrite, comprising Mg_2Z, and/or Mn_2Z, and/or Fe_2Z, and/or Co_2Z, and/or Ni_2Z, and/or Cu_2Z, and/or Zn_2Z;
                the second conductive medium is selected from ZnO series, comprising those doped with Al (AZO), and/or doped with In (IZO), and/or doped with Ga (GZO); magnetic oxides comprising CoO, and/or MnO, and/or Fe_3O_4, and/or NiO; and other semiconductor oxides comprising Ga_2O_3, and/or In_2O_3, and/or InSnO (ITO).

2. The heating medium of the aerosol generating substrate according to claim 1, wherein the first heating medium is formed into a core-shell type, a heterojunction type, a coating type, a porous type or a film composite type through mesoscopic-scale compounding by physical and chemical methods;

    the first heating medium of the core-shell type comprises an electric moment-magnetic moment coupling heating medium 1-H-1 of a core-shell structure, an electric moment-electrical conductance coupling heating medium 1-

H-2 of a core-shell structure or an electric moment-magnetic moment-electrical conductance coupling heating medium 1-H-3 of a core-shell structure;

a specific method of forming the first heating medium of the core-shell type is a direct precipitation method, a co-precipitation method, an alcohol salt hydrolysis method, or a sol-gel method;

the first heating medium of the heterojunction structure comprises an electric moment-magnetic moment coupling heating medium 1-Y-1 of a heterojunction structure, an electric moment-electrical conductance coupling heating medium 1-Y-2 of a heterojunction structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 1-Y-3 of a heterojunction structure;

a specific method of forming the first heating medium of the heterojunction structure is a molten salt method, or a high-heat solid-phase reaction method, or a mechanical alloying method, and a precipitation method of controlling the calcination temperature, or an alcohol salt hydrolysis method, or a hydrothermal method, or a sol (gel)-hydrothermal method;

the first heating medium of the coating structure comprises an electric moment-magnetic moment coupling heating medium 1-B-1 of a coating structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 1-B-2 of a coating structure;

a specific method of forming the first heating medium of the coating structure is a mechanical fusion coating method, or a mechanochemical effect method induced by a high-energy mill, or a low-heat solid-phase reaction method, or a sol-gel method;

the first heating medium of a porous structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of a porous structure, or a heating medium 1-D of a low excitation temperature aerosol generating substrate;

the first heating medium of the film composite structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 1-M;

the second heating medium is formed into a core-shell type, or a heterojunction type, or a coating type, or a porous type or a film composite type through mesoscopic-scale compounding by physical and chemical methods;

the second heating medium of the core-shell type comprises an electric moment-magnetic moment coupling heating medium 2-H-1 of the core-shell structure, an electric moment-electrical conductance coupling heating medium 2-H-2 of the core-shell structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 2-H-3 of the core-shell structure;

a specific method of forming the second heating medium with the core-shell type is a direct precipitation method, or a co-precipitation method, or an alcohol salt hydrolysis method, or a sol-gel method;

the second heating medium of the heterojunction structure comprises an electric moment-magnetic moment coupling heating medium 2-Y-1 of the heterojunction structure, an electric moment-electrical conductance coupling heating medium 2-Y-2 of the heterojunction structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 2-Y-3 of the heterojunction structure;

a specific method of forming the second heating medium of the heterojunction structure is a molten salt method, or a high-heat solid-phase reaction method, or a mechanical alloying method, and a precipitation method of controlling the calcination temperature, or an alcohol salt hydrolysis method, or a hydrothermal method, or a sol (gel)-hydrothermal method;

the second heating medium of the coating structure comprises an electric moment-magnetic moment coupling heating medium 2-B-1 of the coating structure, or an electric moment-magnetic moment-electrical conductance coupling heating medium 2-B-2 of the coating structure;

a specific method of forming the second heating medium of the coating structure is a mechanical fusion coating method, or a mechanochemical effect method induced by a high-energy mill, or a low-heat solid-phase reaction method, or a sol-gel method;

the second heating medium of a porous structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of a porous structure, or a heating medium 2-D of a low excitation temperature aerosol generating substrate;

the second heating medium of the film composite structure is an electric moment-magnetic moment-electrical conductance coupling heating medium 2-M.

3. The heating medium according to claim 2, wherein the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure is prepared according to a following method:

fully mixing ultrafine particles of at least one component of the first dielectric medium, the first magnetic medium and the first conductive medium in the first heating medium with the inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and the pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure; or performing a polymer network gel method on at least one component in the first dielectric medium, at least one component in the first magnetic medium system and at least one component in the first conductive medium to obtain a gel, or performing a metal complex gel method to obtain a soluble complex network gel, and then drying, sintering, crushing and classifying to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure; or modifying the first dielectric medium particle porous body by precipitation method using ions of at least one component of the first magnetic medium and ions of at least one component of the first conductive medium in the solution and a precipitant, so that a composite film layer of the first magnetic medium component and the first conductive medium component is formed on the inner surface of the pores, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure; or fully mixing ultrafine particles of at least one component of the first dielectric medium and the first magnetic medium in the first heating medium with an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and a pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying to obtain the electric moment-magnetic moment coupling heating medium of the porous structure, modifying pores of the electric moment-magnetic moment coupling heating medium of the porous structure by chemical plating method, and the metal ions of at least one component of the first conductive medium system adsorbed in the plating solution in the pores being catalytically reduced to metal by the reducing agent in the plating solution and deposited on the inner surface of the pores to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure;

wherein the electric moment-magnetic moment-electrical conductance coupling heating medium of the porous structure has a pore size of 2nm to 50μm, and a porosity of 70% to 95%;

the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure is prepared according to a following method:

fully mixing ultrafine particles of at least one component of the second dielectric medium, the second magnetic medium and the second conductive medium in the second heating medium with the inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and the pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure; or performing a polymer network gel method on at least one component in the second dielectric medium, at least one component in the second magnetic medium system and at least one component in the second conductive medium to obtain a gel, or performing a metal complex gel method to obtain a soluble complex network gel, and then drying, sintering, crushing and classifying to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure; or modifying the second dielectric medium particle porous body by precipitation method using ions of at least one component of the second magnetic medium system and ions of at least one component of the second conductive medium system in the solution and a precipitant, so that a composite film layer of the second magnetic medium component and the second conductive medium component is formed on the inner surface of the pores, to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure; or fully mixing ultrafine particles of at least one component of the second dielectric medium and the second magnetic medium in the second heating medium with an inorganic binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, and a pore-forming agent ultrafine carbon powder or starch, or ultrafine calcium carbonate, and then sintering, crushing and classifying to obtain the electric moment-magnetic moment coupling heating medium of the porous structure, modifying pores of the electric moment-magnetic moment coupling heating medium of the porous structure by chemical plating method, and the metal ions of at least one component of the second conductive medium adsorbed in the plating solution in the pores being catalytically reduced to metal by the reducing agent in the plating solution and deposited on the inner surface of the pores to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure, wherein the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure has a pore size of 2nm to 50μm and a porosity of 70% to 95%.

4. The heating medium according to claim 3, wherein the heating medium 1-D of the low excitation temperature aerosol generating substrate is prepared according to a following method:

from the electric moment-magnetic moment-electrical conductance coupling heating medium 1-K of the porous structure, selecting particles with a pore size ranging from 60nm to 50μm, a porosity ranging from 85% to 95%, a specific heat capacity ranging from 0.1 $kJ \cdot kg^{-1} \cdot K^{-1}$ to 0.6 $kJ \cdot kg^{-1} \cdot K^{-1}$, and a coefficient of thermal conductivity ranging from 0.035 $W \cdot m^{-1} \cdot K^{-1}$ to 0.125 $W \cdot m^{-1} \cdot K^{-1}$ to adsorb the liquid phase components of the aerosol generating medium, so that the liquid phase components are separated into small droplets entering the pores with a porosity of 85% to 95% and a pore size ranging from 60nm to 50μm, to increase the saturated vapor pressure value of the liquid phase component of the aerosol generating medium, and obtain the heating medium of the low excitation temperature aerosol generating substrate, wherein the excitation temperature is 160°C to 200°C, and the particle size distribution range of the heating medium 1-D of the low excitation temperature aerosol generating substrate is 15μm to 500μm;

the heating medium 2-D of the low excitation temperature aerosol generating substrate is prepared according to the following method:

from the electric moment-magnetic moment-electrical conductance coupling heating medium 2-K of the porous structure, selecting particles with a pore size ranging from 60nm to 50μm, a porosity ranging from 85% to 95%, a specific heat capacity ranging from 0.1 $kJ\cdot kg^{-1}\cdot K^{-1}$ to 0.6 $kJ\cdot kg^{-1}\cdot K^{-1}$, and a coefficient of thermal conductivity ranging from 0.035 $W\cdot m^{-1}\cdot K^{-1}$ to 0.125 $W\cdot m^{-1}\cdot K^{-1}$ to adsorb the liquid phase components of the aerosol generating medium, so that the liquid phase components are separated into small droplets entering the pores with a porosity of 85% to 95% and a pore size ranging from 60nm to 50μm, to increase the saturated vapor pressure value of the liquid phase components of the aerosol generating medium, and obtain the heating medium of the low excitation temperature aerosol generating substrate, wherein the excitation temperature is 160°C to 200°C, and the particle size distribution range of the heating medium 2-D of the low excitation temperature aerosol generating substrate is 15μm to 500μm.

5. The heating medium according to claim 1, wherein the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M is prepared according to the following method:

fully mixing the ultrafine particles of at least one component of the first dielectric medium and the first magnetic medium and the first conductive medium systems in the first heating medium with the binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, performing a single-sided or double-sided film composite on an aluminum sheet, a copper sheet, or a stainless steel sheet by a spraying method or a brushing method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M of the film composite structure; or performing a single-sided or double-sided film composite depositing or spraying on an aluminum sheet, a copper sheet, or a stainless steel sheet by a vapor deposition method, a flame vapor deposition method, or a plasma spraying method using the particles of at least one component of the first dielectric medium and the first magnetic medium and the first conductive medium systems in the first heating medium to prepare the electric moment-magnetic moment-electrical conductance coupling heating medium 1-M of the film composite structure;

the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M is prepared according to the following method:

fully mixing the ultrafine particles of at least one component in the second dielectric medium, the second magnetic medium and the second conductive medium systems in the second heating medium with the binder sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide, performing a single-sided or double-sided film composite on an aluminum sheet, a copper sheet or a stainless steel sheet by a spraying method or a brushing method to obtain the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M of the film composite structure; or performing a single-sided or double-sided film composite depositing or spraying on an aluminum sheet, a copper sheet, or a stainless steel sheet by a vapor deposition method, a flame vapor deposition method, or a plasma spraying method using the particles of at least one component of the second dielectric medium and the second magnetic medium and the second conductive medium systems in the second heating medium to prepare the electric moment-magnetic moment-electrical conductance coupling heating medium 2-M of the film composite structure.

6. The heating medium according to claim 4, wherein the aerosol generating substrate further comprises a gas-mist substrate;

the heating medium is directly blended with the gas-mist substrate, or the heating medium is mixed into the fiber slurry or paste before the tobacco sheet in the gas-mist substrate is manufactured or roller-pressed, so that the tobacco sheet is uniformly distributed with a heating medium of 5% to 60% by mass, and the particle size of the heating medium is 0.1 μm to 100 μm;

or the heating medium of a porous structure of 15 μm to 100 μm or the heating medium of a low excitation temperature aerosol generating substrate with a particle size of 15 μm to 100μm absorbs the liquid phase components in the gas-mist substrate, and then blends with the heating medium and the gas-mist substrate.

7. The heating medium according to claim 1, the aerosol generating substrate further comprises a foil-like film composite heating medium;
the foil-like film composite heating medium is prepared by mixing the heating medium particles with the binder carboxymethyl cellulose, or guar gum or tobacco extract, and then performing a single-sided or double-sided film composite on an aluminum foil or copper foil using a casting method or a spraying method, and then cutting to a size equivalent to that of tobacco sheets, the particle size distribution range of the heating medium particles is 15μm to 100μm; or prepared by using the dielectric medium component and the precursor of the magnetic medium component by a chemical vapor deposition method, or a gas phase pyrolysis method, or a gas phase hydrolysis method, or a gas phase combustion method, or a flame vapor deposition method.

8. An aerosol generating system using multi-caloric coupling giant caloric effect, wherein the aerosol generating system comprises a heating structure, the heating structure comprises a housing, and the housing is provided with a housing air inlet;

a preheating shell is provided inside the housing; the housing and the preheating shell are coaxially opened;
an opening of the preheating shell is connected to the filter section; the preheating shell is provided with a preheating shell air inlet;
a plurality of electrode plates are provided inside the preheating shell; the plurality of electrode plates form a heating chamber;
a heating chamber base is provided at the bottom of the heating chamber; a temperature control unit passes through the central hole of the heating chamber base, and a base disc air inlet is provided on the heating chamber base;
an upper end of the heating chamber is connected to a sealing ring and nested in the opening of the preheating shell;
an interior of the electrode plate is an aerosol generating section; a metal particle layer filter medium is provided between the aerosol generating section and the filter section;
the aerosol generating section contains an aerosol generating substrate 1;
the electrode plate is connected to a heating drive unit through an electrode plate feeder;
the aerosol generating substrate 1 comprises the first heating medium according to claim 1.

9. The heating structure according to claim 8, wherein the electrode plate is a tubular electrode plate; the tubular electrode plate comprises a tubular insulating ceramic substrate, and a curved electrode 1 and a curved electrode 2 arranged on an inner surface of the tubular insulating ceramic substrate;

the curved electrode 1 and the curved electrode 2 are arranged in pieces and are opposite to each other; the adjacent curved electrodes 1 and the curved electrodes 2 are separated by insulating materials;
the number of the curved electrode 1 and the curved electrode 2 is respectively within the range from 2 to 5.

10. The heating structure according to claim 8, wherein the electrode plate is a plurality of planar electrodes; the electrode plate comprises a planar electrode plate 1 and a planar electrode plate 2 which are parallel and opposite to each other; a distance between the planar electrode plate 1 and the planar electrode plate 2 is the diameter of the aerosol generating section.

11. The heating structure according to claim 8, wherein a block heating medium 1 is sandwiched between each of two pairs of corresponding ends of the planar electrode plate 1 and the planar electrode plate 2;
a cylindrical hole is arranged at the symmetric center of the two sandwiched block heating media 1, and a diameter of the cylindrical hole is a diameter of the aerosol generating section.

12. The heating structure according to claim 8, wherein a thickness of the metal particle layer filter medium is 0.2mm to 1.2mm;
the metal particle layer filter medium is formed by pressing aluminum particles with a size of 0.5 to 1.5mm.

13. The heating structure according to claim 8, wherein the block heating medium 1 comprises first heating medium particles and an inorganic binder; the inorganic binder is selected from one or more of sodium silicate, aluminum dihydrogen phosphate and phosphoric acid-copper oxide.

14. The heating structure according to claim 8, wherein the base disc air inlet is a through hole with a diameter of 0.3 to 2mm;

a number of the air inlet is 8 to 36.

15. The heating structure according to claim 8, wherein a frequency of the alternating electromagnetic field used in the heating drive unit has a balanced compatible response frequency that meets the requirements of multi-caloric coupling of electric caloric, magnetic caloric and conductive caloric for multi-field coupling drive, when the compatible response frequency is in a range of 0.3MHz to 300MHz, it is suitable for the first heating medium.

16. The heating structure according to claim 8, wherein the inner surface of the preheating shell is provided with a first heating medium particle coating;

the first heating medium particle coating comprises a hexagonal boron carbon nitrogen ternary wave absorbing ceramic substrate and a coating coated on the substrate, the coating comprises first heating medium particles and a film-forming agent; the film-forming agent is selected from sodium silicate sol, or aluminum dihydrogen phosphate sol, or aluminum hydroxide sol, or silica sol;
or the first heating medium particle coating comprises a metal substrate and a coating coated on the metal substrate, the coating comprises first heating medium particles and an inorganic binder;
the inorganic binder is selected from sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide.

17. An aerosol generating system using multi-caloric coupling giant caloric effect, wherein the aerosol generating system comprises a heating structure, the heating structure comprises a housing, and the housing is provided with a housing air inlet;

a preheating shell is provided inside the housing; the housing and the preheating shell are coaxially opened;
an opening of the preheating shell is connected to the filter section; the preheating shell is provided with a preheating shell air inlet;
an interior of the preheating shell is provided with a metal shielding shell, a block heating medium 2 and an antenna embedded in the block heating medium 2; the metal shielding shell is wrapped around the outside of the block heating medium 2;
the metal shielding shell, the block heating medium 2 and the antenna embedded in the block heating medium 2 form a heating chamber;
an air inlet seat hole of the heating chamber communicates with the outside of the block heating medium 2 through 4 to 10 air inlet channels with a diameter of 0.5 to 2mm;
the block heating medium 2 is a cube; a cylindrical hole is arranged at the symmetry axis of the block heating medium 2, and an aerosol generating section is formed inside the hole; a wave-transmitting ceramic tube is nested in the cylindrical hole, and the inner diameter of the wave-transmitting ceramic tube is the diameter of the aerosol generating section;
the upper end of the heating chamber is connected to the sealing ring and nested in the opening of the preheating shell;
a metal particle layer filter medium is provided between the aerosol generating section and the filter section;
the aerosol generating section contains an aerosol generating substrate 2;
the antenna is connected to the heating drive unit through the antenna feeder pin;
the aerosol generating substrate 2 comprises the second heating medium according to claim 1.

18. The heating structure according to claim 17, wherein the wave-transmitting ceramic tube is selected from a quartz SiO_2 ceramic tube, a high alumina ceramic tube, or a Si_3N_4 ceramic tube.

19. The heating structure according to claim 17, further comprising a temperature control unit, the temperature control unit is transversely placed on the inner surface of the wave-transmitting ceramic tube at a position of 2-3 mm away from a free port of the aerosol generating section.

20. The heating structure according to claim 17, wherein the block heating medium 2 comprises second heating medium particles and an inorganic binder; the inorganic binder is selected from sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide.

21. The heating structure according to claim 17, wherein a second heating medium particle coating is provided on the inner surface of the preheating shell;

the second heating medium particle coating comprises a hexagonal boron carbon nitrogen ternary wave absorbing ceramic substrate and a coating coated on the substrate, and the coating comprises the second heating medium particles and a film-forming agent; the film-forming agent is selected from sodium silicate sol, or aluminum dihydrogen phosphate sol, or aluminum hydroxide sol, or silica sol;
or the second heating medium particle coating comprises a metal substrate and a coating coated on the metal substrate, and the coating comprises second heating medium particles and an inorganic binder;
the inorganic binder is selected from sodium silicate, or aluminum dihydrogen phosphate, or phosphoric acid-copper oxide.

22. The heating structure according to claim 17, wherein the frequency of the alternating electromagnetic field used by the heating drive unit has a balanced compatible response frequency that meets requirements of multi-caloric coupling of electric caloric, magnetic caloric and conductive caloric for multi-field coupling driving, when the compatible response frequency is in a range from 0.3GHz to 30GHz, it is suitable for the second heating medium.

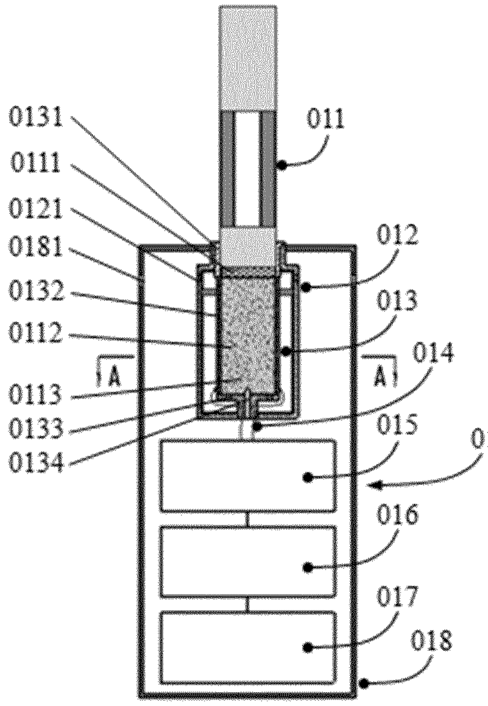
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FIG. 1

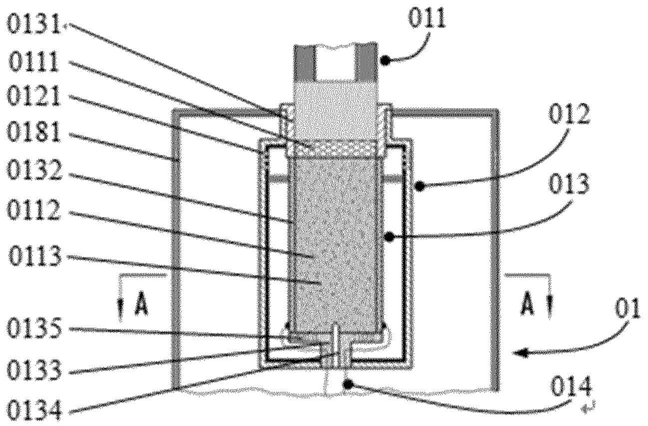

FIG. 2

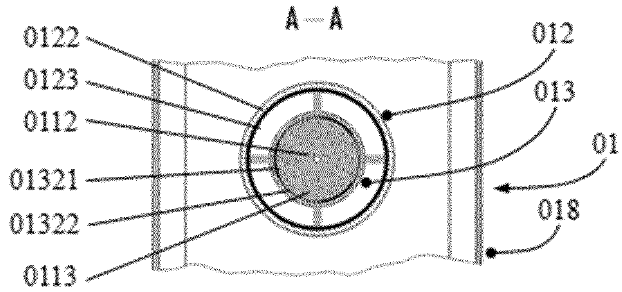

FIG. 3

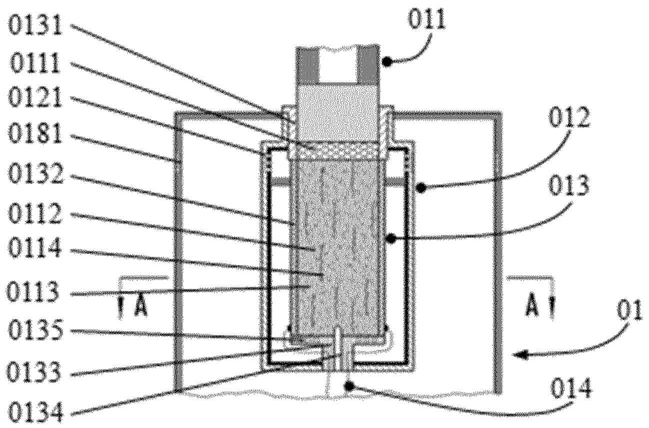

FIG. 4

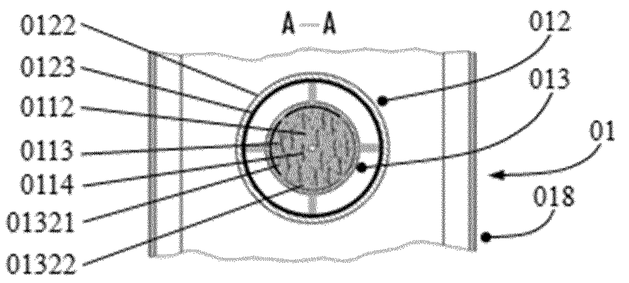

FIG. 5

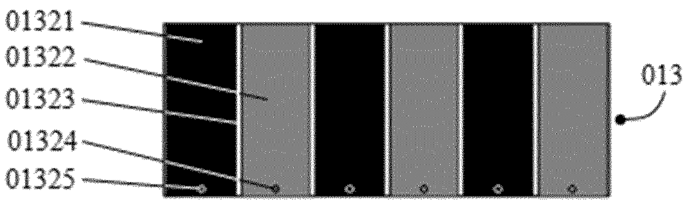

FIG. 6

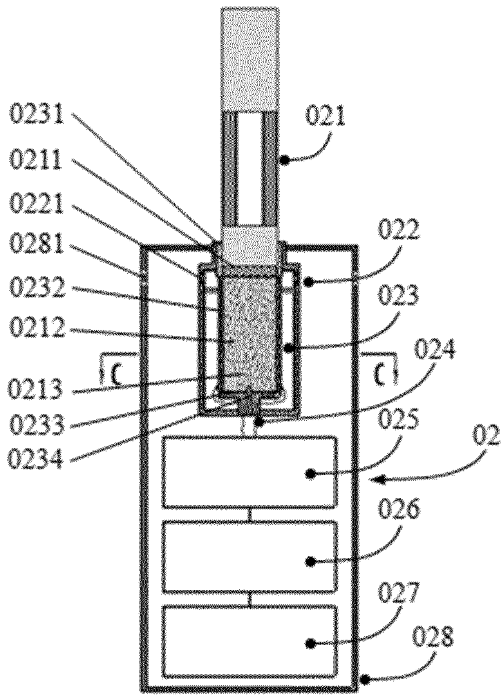

FIG. 7

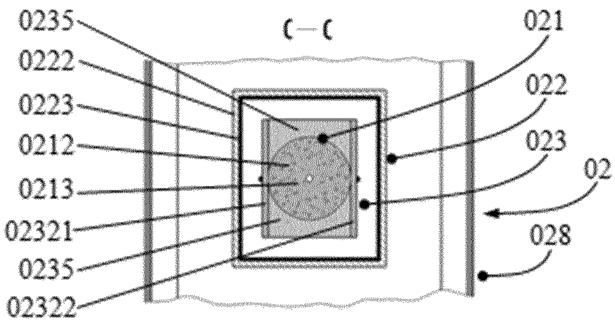

FIG. 8

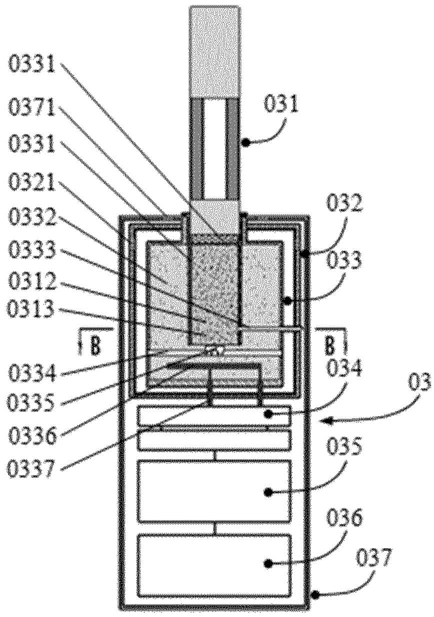

FIG. 9

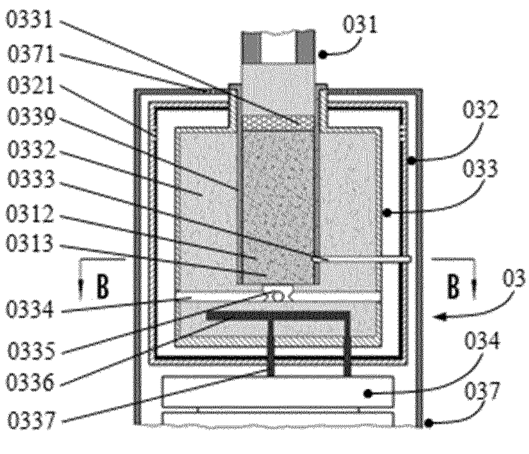

FIG. 10

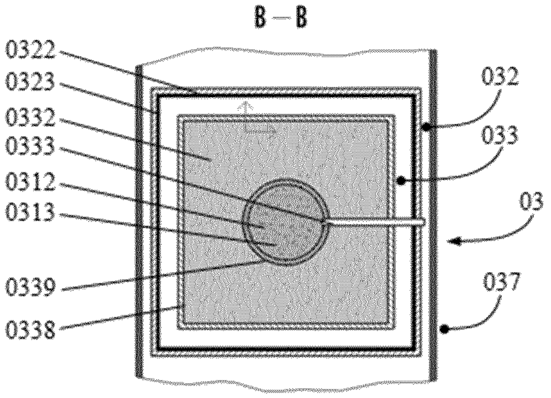

FIG. 11

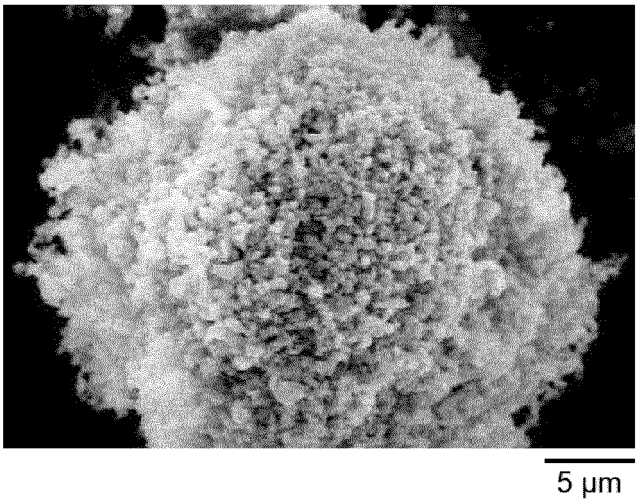

FIG. 12

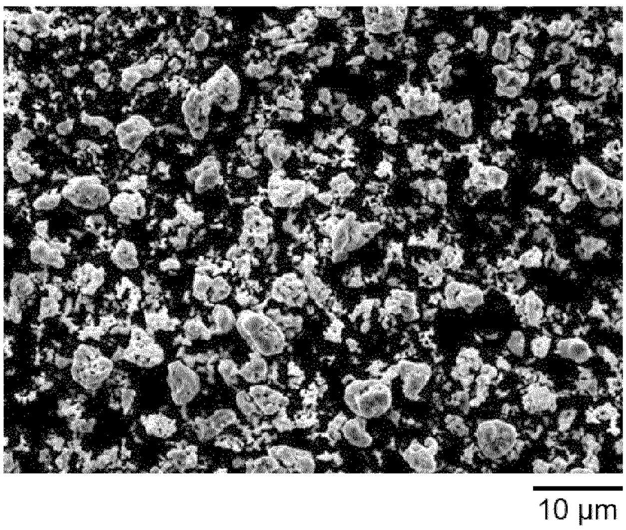

FIG. 13

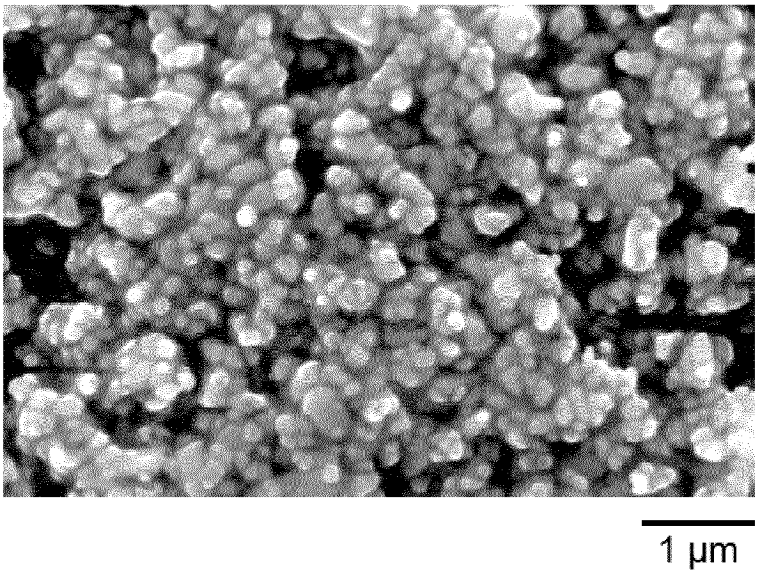

FIG. 14

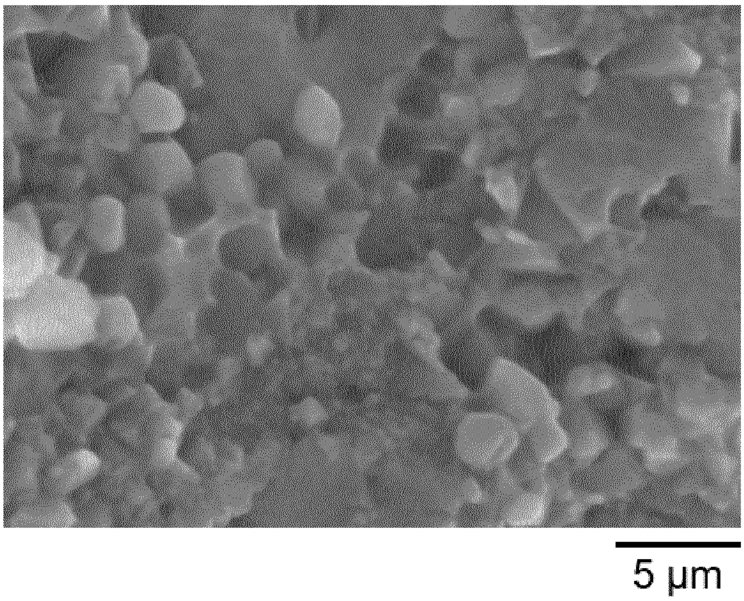

FIG. 15

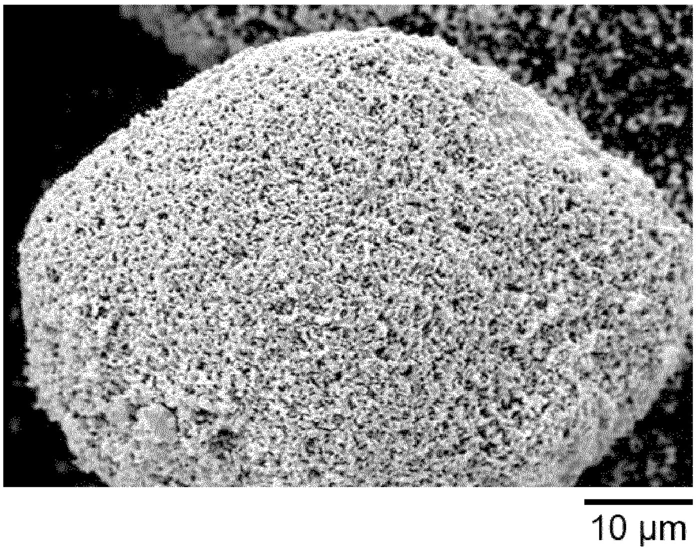

FIG. 16

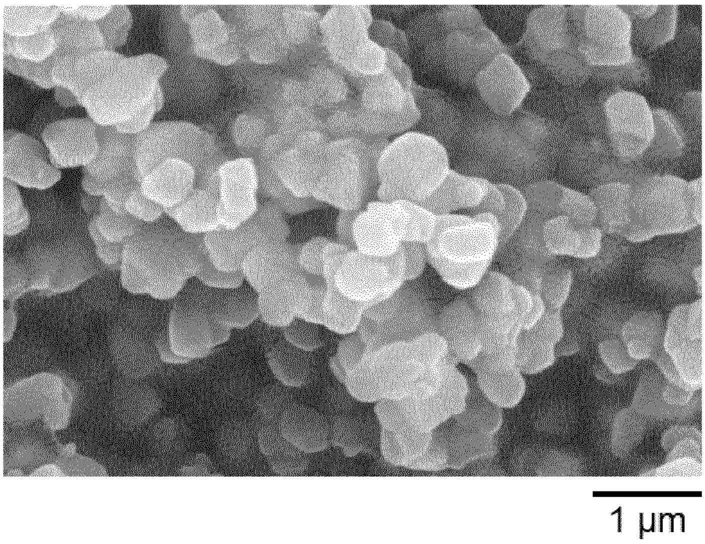

FIG. 17

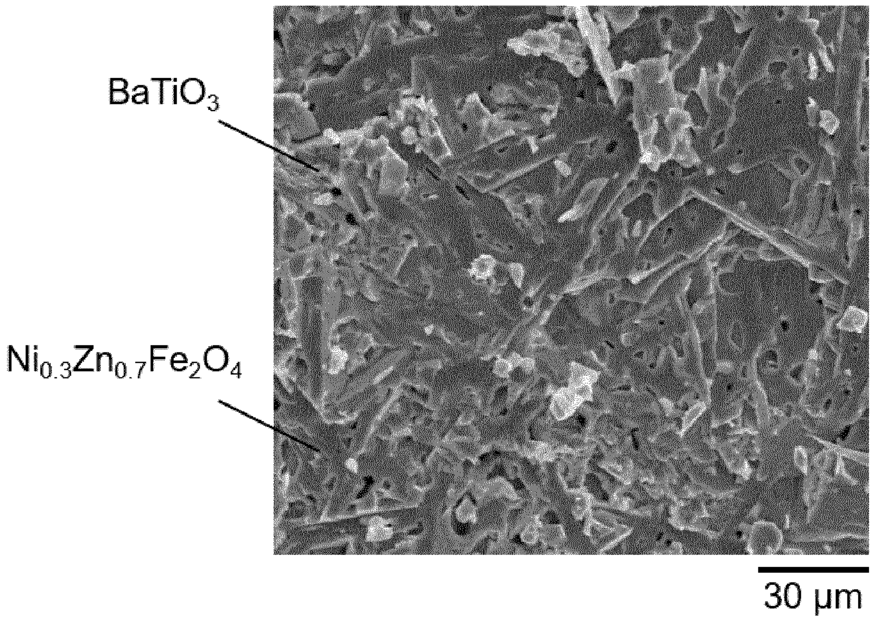

FIG. 18

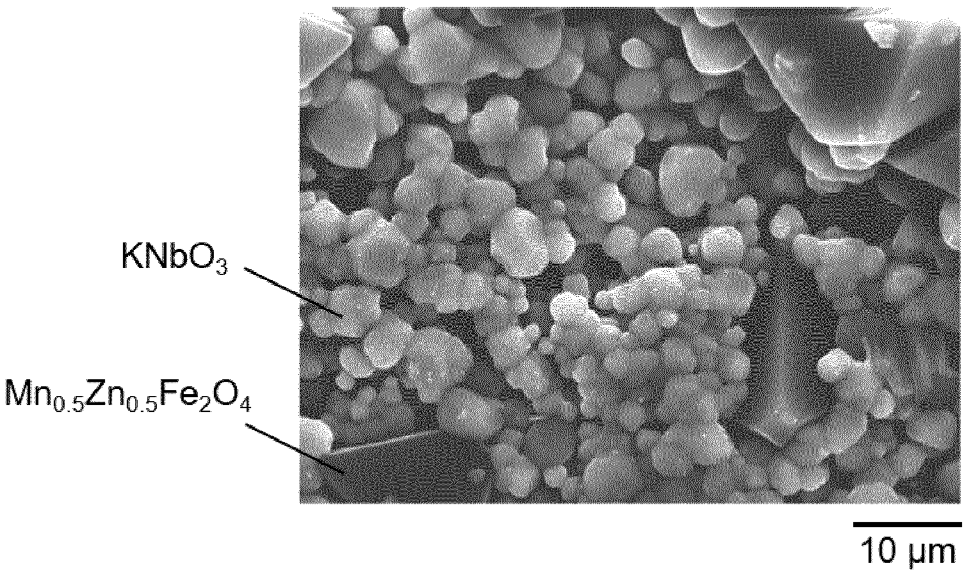

FIG. 19

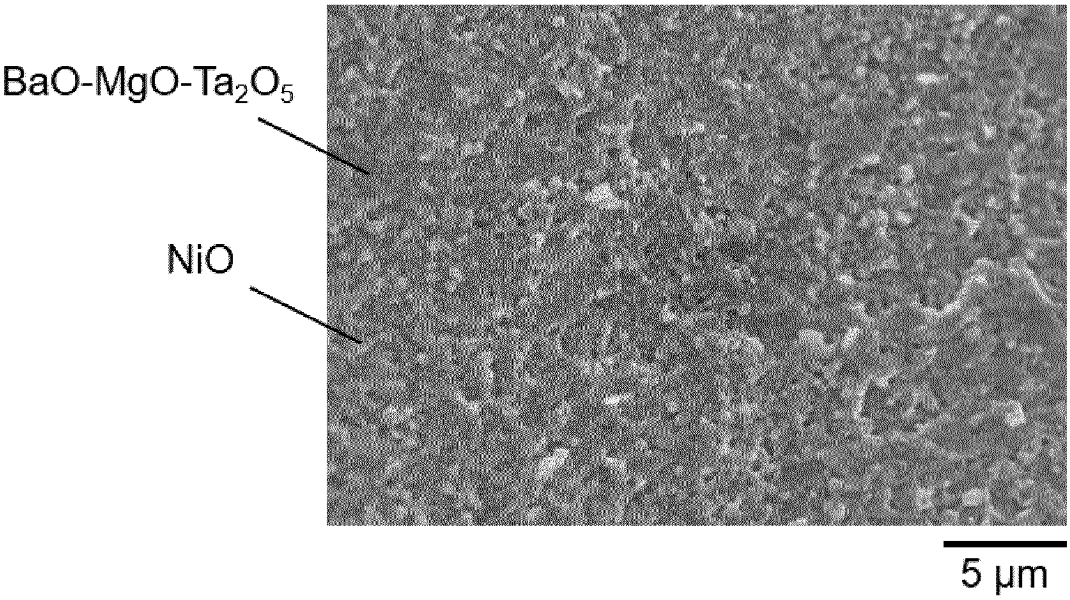

FIG. 20

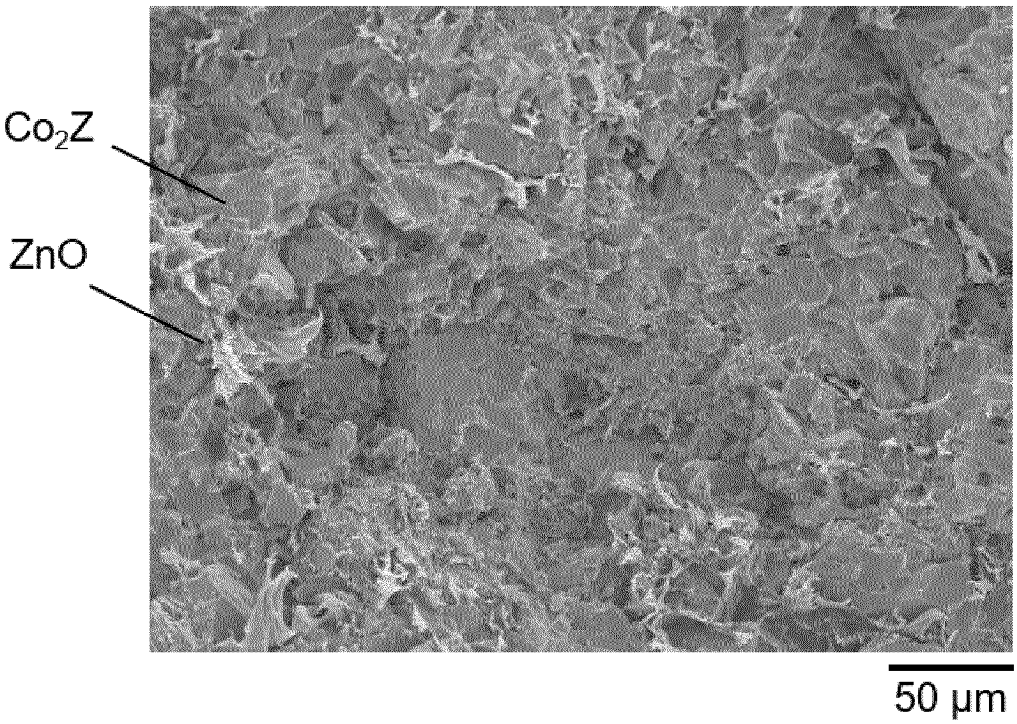

FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/135146

A. CLASSIFICATION OF SUBJECT MATTER

A24F40/40(2020.01)i;A24F40/50(2020.01)i;A24F47/00(2020.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A24F 40; A24F 47; A24D 1; H05B 6

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CJFD, CNTXT, DWPI, ENTXT, ENTXTC, VEN, WPABS, WPABSC: 湖北中烟工业有限公司, 菲利普莫里斯生产公司, PHILIP MORRIS PRODUCTS, 加热, 发热, 雾化, heat+, pulverizat+, atomizat+, nebulizat+, 介电, 电介质, 电矩, electric w (moment or torque), dielectric, 钙钛矿结构, Ta2O5-ZrO2, 焦绿石结构, 偏铌酸铅, 钨青铜结构, 铋层状结构, 磁, magnetic, 铁氧体, ferrite, 铁素体, 电导, conducitive, 导电, 耦合, 协同, coupl+, synerg+, cooperat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 114617298 A (HUBEI CHINA TOBACCO INDUSTRY CO., LTD.) 14 June 2022 (2022-06-14) claims 1-22	1-22
A	WO 2021245190 A1 (PHILIP MORRIS PRODUCTS S.A.) 09 December 2021 (2021-12-09) description, p. 2, lines 11-21, and p. 3, line 19 to p. 6, line 33, and figures 1-2	1-22
A	WO 2017167521 A1 (PHILIP MORRIS PRODUCTS S.A.) 05 October 2017 (2017-10-05) description, p. 8, lines 17-24	1-22
A	CN 110430769 A (PHILIP MORRIS PRODUCTS S.A.) 08 November 2019 (2019-11-08) entire document	1-22
A	WO 2021219730 A1 (PHILIP MORRIS PRODUCTS S.A.) 04 November 2021 (2021-11-04) entire document	1-22
A	US 2017224018 A1 (SHENZHEN FIRST UNION TECHNOLOGY CO., LTD.) 10 August 2017 (2017-08-10) entire document	1-22

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 February 2023	**26 February 2023**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/135146

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