[0098] In some embodiments, the reflective layer 2 can include a resin reflective layer 22 having a plurality of third pores 220. A volume fraction of the plurality of third pores 220 in the resin reflective layer 22 can be in a range of 2% to 30%. The volume fraction of the plurality of third pores 220 in the resin reflective layer 22 can be in a range of 5% to 15%. The volume fraction of the plurality of third pores 220 in the resin reflective layer 22 can also be in a range of 8% to 10%. The plurality of third pores 220 can refract and scatter the light entering the resin reflective layer 22, thereby increasing reflectivity of the resin reflective layer 22 and improving reflectivity of the reflective layer 2. A color of the resin reflective layer 22 can be light such as white or transparent.

[0099] In some embodiments, a pore size of the plurality of third pores can be in a range of 0.2 μm to 20 μm.

[00100] It should be noted that the shape, size and the like of the plurality of third pores 220 in FIGs. 4 and 5 are schematically illustrated, and it is not meant that the pore 220 of the present disclosure must have the shape and size shown in the figure. The distribution of the plurality of third pores 220 in the resin reflective layer 22 is also not limited to that shown in the drawing.

[00101] The resin reflective layer 22 can be poly-4-methyl-pentene (TPX), polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polyethylene naphthalate (PEN), acrylonitrile-butadiene-styrene copolymer (ABS), polystyrene (PS), polypropylene (PP), or polycarbonate (PC). A thickness of the resin reflective layer 22 can be in a range of 25 μm to 300 μm. Preferably, the thickness of the resin reflective layer 22 can be in a range of 50 μm to 150 μm.

[00102] The resin reflective layer 22 may be a single layer structure or a multilayer structure. Referring to FIG. 4, the resin reflective layer 22 can preferably include a first resin reflective layer 221, a second resin reflective layer 222, and a third resin reflective layer 223 which are sequentially arranged. The plurality of third pores 220 can be formed in the second resin reflective layer 222.

[00103] In some embodiments, a thickness of the first resin reflective layer and a thickness of the third resin reflective layer can be in a range of 1 μm to 50 μm, and a thickness of the second resin reflective layer can be in a range of 20 μm to 300 μm.

embedded in the plurality of first pores, the average pore size of the plurality of second pores in the second emissive layer is about 100 nm, the volume fraction of the plurality of second pores in the second emissive layer is about 8%, and the $SiO_2$ particles of about 3% volume fraction are embedded in the plurality of second pores.

[00171] After testing, the solar reflectivity R in a wavelength range of 300 nm to 2500 nm of the composite radiative cooling film was about 92.72% and the infrared emissivity E in a wavelength range of 7 μm to 14 μm of the composite radiative cooling film was about 94.68%.

[00172] Comparative embodiment 1

[00173] A composite radiative cooling film includes an emissive layer and a metal reflective layer from top to bottom.

[00174] A thickness of the emissive layer is about 50 μm. The emissive layer includes a PET polymer and $SiO_2$ particles. An average particle size of the $SiO_2$ particles is about 200 nm. A volume fraction of the additive ($SiO_2$ particles) in the emissive layer is about 20%.

[00175] A thickness of the metal reflective layer is about 200 nm and the metal reflective layer is an aluminum layer located on the emissive layer.

[00176] After testing, the solar reflectivity R in a wavelength range of 300 nm to 2500 nm of the composite radiative cooling film was about 91.93% and the infrared emissivity E in a wavelength range of 7 μm to 14 μm of the composite radiative cooling film was about 83.85%.

[00177] Comparative embodiment 2

[00178] A composite radiative cooling film includes an emissive layer and a metal reflective layer from top to bottom.

[00179] A thickness of the emissive layer is about 150 μm. The emissive layer includes TPX polymer and $SiO_2$ particles. An average particle size of the $SiO_2$ particles is about 20 μm, and a volume fraction of the additive ($SiO_2$ particles) in the emissive layer is about 15%.

[00180] A thickness of the metal reflective layer is about 250 nm and the metal reflective layer is a silver layer located on the emissive layer.

[00181] After testing, the solar reflectivity R in a wavelength range of 300 nm to 2500 nm of the composite radiative cooling film was about 92.39% and the infrared emissivity E in a wavelength range of 7 μm to 14 μm of the composite radiative cooling film was about 83.66%.

[00182] Comparative embodiment 3

[00183] A composite radiative cooling film includes an emissive layer and a metal reflective layer from top to bottom.

[00184] A thickness of the emissive layer is about 50 μm. The emissive layer includes a PET polymer, $CaCO_3$ particles and $SiO_2$ particles. The $CaCO_3$ particles and the $SiO_2$ particles are substantially uniformly dispersed in the PET polymer. An average particle size of the $CaCO_3$ particles is about 500 nm. An average particle size of the $SiO_2$ particles is about 50 μm. A volume fraction of $CaCO_3$ particles in the emissive layer is about 8%. And a volume fraction of $SiO_2$ particles in the emissive layer is about 12%.

[00185] A thickness of the metal reflective layer is about 250 nm and the metal reflective layer is a silver layer located on the emissive layer.

[00186] After testing, the solar reflectivity R in a wavelength range of 300 nm to 2500 nm of the composite radiative cooling film was about 93.07% and the infrared emissivity E in a wavelength range of 7 μm to 14 μm of the composite radiative cooling film was about 84.72%.

[00187] Comparative embodiment 4

[00188] A composite radiative cooling film includes a second emissive layer, a first emissive layer, and a metal reflective layer from top to bottom.

[00189] A thickness of the second emissive layer is about 20 μm and the second emissive layer includes a PVDF polymer.

[00190] A thickness of the first emissive layer is about 5 μm. The first emissive layer includes a TPX polymer and a plurality of first pores. An average pore size of the plurality of first pores is about 5 μm. A volume fraction of the plurality of first pores in the first emissive layer is about 15%.

[00191] A thickness of the metal reflective layer is about 200 nm and the metal reflective layer is a silver layer located on the first emissive layer.

[00192] After testing, the solar reflectivity R in a wavelength range of 300 nm to 2500 nm of the composite radiative cooling film was about 92.78% and the infrared emissivity E in a wavelength range of 7 μm to 14 μm of the composite radiative cooling film was about 91.37%.

[00193] Comparative embodiment 5

[00194] A composite radiative cooling film includes a second emissive layer, a first emissive layer, and a metal reflective layer from top to bottom.

CLAIMS (amended, clean version)

We claim:

1.A composite radiative cooling film comprising a top layer and a reflective layer disposed below the top layer, a material of the top layer comprises at least one polymer, the at least one polymer has an emissivity that is greater than or equal to 80% in a wavelength range of 7 μm to 14 μm;

the top layer comprises a first emissive layer adjacent to the reflective layer and a second emissive layer away from the reflective layer, a material of the first emissive layer comprises a first polymer, the first emissive layer further comprises a plurality of first pores, the plurality of first pores are distributed in the first emissive layer, a material of the second emissive layer comprises a second polymer, the second emissive layer further comprises a plurality of second pores, the plurality of second pores are distributed in the second emissive layer, a pore size of the plurality of first pores is in a range of 1 μm to 20 μm, and a pore size of the plurality of second pores is in a range of 1 nm to 200 nm,

wherein the first emissive layer further comprises a first additive embedded in at least part of the plurality of first pores.

2. The composite radiative cooling film of claim 1, wherein a volume fraction of the plurality of first pores in the first emissive layer is in a range of 1% to 20%, and a volume fraction of the plurality of second pores in the second emissive layer is in a range of 1% to 20%.

3. The composite radiative cooling film of claim 1 or claim 2, wherein the second emissive layer further comprises a second additive embedded in at least part of the plurality of second pores.

4. The composite radiative cooling film of claim 3, wherein a particle size of the first additive is in a range of 1 μm to 20 μm; and/or

a particle size of the second additive is in a range of 1 nm to 200 nm.

5. The composite radiative cooling film of claim 3, wherein a volume fraction of the first additive in the first emissive layer is in a range of 0% to 20%, and a volume fraction of the second additive in the second emissive layer is in a range of 0% to 20%.

6. The composite radiative cooling film of claim 3, wherein the first additive and the second additive respectively comprise an inorganic filler comprising glass beads, silicon oxide

particles, silicon carbide particles, silicon nitride particles, barium sulfate particles, calcium carbonate particles, or a combination thereof; and/or

the first additive and the second additive respectively comprise an organic filler comprising a polymer containing a C-O functional group, a polymer containing a C-Cl functional group, a polymer containing a C-F functional group, a polymer containing a C-N functional group, a polymer containing a C-Si functional group, a polymer containing a Si-O functional group, or a combination thereof.

7. The composite radiative cooling film of claim 6, wherein the organic filler comprises polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polycarbonate, polyvinyl chloride, polymethyl methacrylate, polyvinylidene fluoride, teflon, fluorinated ethylene propylene, polydimethylsiloxane, polyurethane, or a combination thereof.

8. The composite radiative cooling film of claim 3, wherein the first additive and the second additive respectively comprise an organic filler comprising poly-4-methyl-pentene, poly-4-methyl-1-pentene, polyethylene, polypropylene, polystyrene, or a combination thereof.

9. The composite radiative cooling film of claim 1, wherein the first polymer comprises poly-4-methyl-pentene, poly-4-methyl-1-pentene, polyethylene, polypropylene, polystyrene, or a combination thereof, and the second polymer comprises acrylic resin, polyurethane resin, fluorine resin, or a combination thereof.

10. The composite radiative cooling film of claim 1, wherein the first polymer comprises a polymer containing a C-O functional group, a polymer containing a C-Cl functional group, a polymer containing a C-F functional group, a polymer containing a C-N functional group, a polymer containing a C-Si functional group, a polymer containing a Si-O functional group, or a combination thereof.

11. The composite radiative cooling film of claim 10, wherein the first polymer comprises polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polycarbonate, polyvinyl chloride, polymethyl methacrylate, polyvinylidene fluoride, teflon, fluorinated ethylene propylene, polydimethylsiloxane, polyurethane, or a combination thereof.

12. The composite radiative cooling film of claim 1, wherein a plurality of convex portions is distributed on a side surface of the second emissive layer away from the first emissive layer.

13. The composite radiative cooling film of claim 12, wherein a height of the plurality of convex portions is in a range of 1 μm to 100 μm.

14. The composite radiative cooling film of claim 1, wherein a thickness of the first emissive layer is in a range of 10 μm to 300 μm, and a thickness of the second emissive layer is in a range of 5 μm to 150 μm.

15. The composite radiative cooling film of claim 1, wherein the reflective layer comprises a metal reflective layer, and a material of the metal reflective layer comprises gold, silver, aluminum, copper, zinc, or a combination thereof.

16. The composite radiative cooling film of claim 15, wherein the metal reflective layer comprises a first metal reflective layer adjacent to the top layer and a second metal reflective layer away from the top layer, a material of the first metal reflective layer is the same as or different from that of the second metal reflective layer, a thickness of the first metal reflective layer is in a range of 5 nm to 200 nm, and a thickness of the second metal reflective layer is in a range of 5 nm to 200 nm.

17. The composite radiative cooling film of claim 16, wherein the metal reflective layer further comprises an intermediate layer disposed between the first metal reflective layer and the second metal reflective layer.

18. The composite radiative cooling film of claim 1, wherein the reflective layer comprises a resin reflective layer and the resin reflective layer comprises a plurality of third pores.

19. The composite radiative cooling film of claim 18, wherein a pore size of the plurality of third pores is in a range of 0.2 μm to 20 μm.

20. The composite radiative cooling film of claim 18 or claim 19, wherein the resin reflective layer comprises a first resin reflective layer, a second resin reflective layer, and a third resin reflective layer which are sequentially arranged, and the plurality of third pores are distributed in the second resin reflective layer.

21. The composite radiative cooling film of claim 20, wherein a volume fraction of the plurality of third pores in the second resin reflective layer is in a range of 2% to 30%.

22. The composite radiative cooling film of claim 18, wherein a thickness of the resin reflective layer is in a range of 25 μm to 300 μm.

23. The composite radiative cooling film of claim 18, wherein a material of the resin reflective layer comprises poly-4-methyl-pentene, polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, acrylonitrile butadiene styrene copolymer, polystyrene, polypropylene, polycarbonate, or combination thereof.

24. The composite radiative cooling film of claim 1, wherein the reflective layer comprises a metal reflective layer adjacent to the top layer and a resin reflective layer away from the top layer.

25. A composite radiative cooling film assembly, wherein the composite radiative cooling film assembly is formed by the composite radiative cooling film of any one of claims 1-24 and a substrate, the reflective layer of the composite radiative cooling film is disposed on a surface of the substrate.

26. The composite radiative cooling film assembly of claim 25, wherein the substrate comprises metal, plastic, rubber, asphalt, a waterproof material, concrete, cement, textile, woven fabric, wood, ceramic tile, glass product, an organic synthetic material, or a combination thereof.

27. An use of the composite radiative cooling film of any one of claims 1-24, comprising:

disposing the composite radiative cooling film on a heat dissipating body; and

thermally communicating the composite radiative cooling film with the heat dissipating body.