CLAIMS

1. A composition for maintaining its surrounding environment at a sub-zero temperature range, the composition comprising:
   (i) a phase change material (PCM); and
   (ii) one or more electrospun carbon fiber(s),
   wherein the composition is in the form of a fluid.

2. The composition of claim 1, wherein the sub-zero temperature range is from -20.0°C to -9.0°C.

3. The composition of any one of the preceding claims, wherein the electrospun carbon fiber is doped with a dopant selected from the group consisting of metal particles, metal oxide particles, and combinations thereof.

4. The composition of any one of the preceding claims, wherein the electrospun carbon fiber is doped with from 1.0 wt% to 80.0 wt% of the dopant.

5. The composition of any one of claims 3 to 4, wherein the dopant comprises one or more types of transition metal atoms selected from the group consisting of copper (Cu), zinc (Zn), nickel (Ni), cobalt (Co), iron (Fe), manganese (Mn), chromium (Cr), vanadium (V), titanium (Ti), scandium (Sc), yttrium (Y), zirconium (Zr), niobium (Nb), molybdenum (Mo), technetium (Tc), ruthenium (Ru), rhodium (Rh), palladium (Pd), silver (Ag), cadmium (Cd), lanthanum (La), hafnium (Hf), tantalum (Ta), tungsten (W), rhenium (Re), osmium (Os), iridium (Ir), platinum (Pt), gold (Au), mercury (Hg), actinium (Ac), and combinations thereof.

6. The composition of any one of the preceding claims, wherein a surface of the electrospun carbon fiber is functionalized with hydrophilic groups and/or hydrophobic groups.

7. The composition of any one of the preceding claims, wherein the phase change material (PCM) comprises organic PCM and/or inorganic PCM.

8. The composition of any one of the preceding claims, wherein the phase change material (PCM) comprises at least one organic phase change materials (PCMs) selected from the group consisting of fatty acid, wax, paraffin and combinations thereof.

9. The composition of any one of the preceding claims, wherein the organic PCMs comprise fatty acid selected from the group consisting of straight, branched or alicyclic carboxylic acids having 2 to 48 carbon atoms.

10. The composition of any one of the preceding claims, wherein the organic PCMs comprise wax or paraffin represented by general formula (1):

$$C_nH_{2n+2} \quad (1)$$

where n = 2 to 48.

11. The composition of any one of the preceding claims, wherein the phase change material (PCM) comprises at least one inorganic phase change materials (PCMs) selected from the group consisting of metal salts, alkaline metal salts, alkaline-earth metal salts and combinations thereof.

12. The composition of any one of the preceding claims, wherein the alkaline metal salts are selected from the group consisting of lithium (Li) salts, sodium (Na) salts, potassium (K) salts, rubidium (Rb) salts, caesium (Cs) salts, francium (Fr) salts and combinations thereof.

13. The composition of any one of the preceding claims, wherein the alkaline-earth metal salts are selected from the group consisting of beryllium (Be)

salts, magnesium (Mg) salts, calcium (Ca) salts, strontium (Sr) salts, barium (Ba) salts, radium (Ra) salts and combinations thereof.

14. The composition of any one of the preceding claims, the composition further comprising one or more of the following additives:
(A) conductive nanoparticle/nanostructure;
(B) insulation/insulative material;
(C) fire retardant;
(D) thickening agent;
(E) nucleating agent; and
(F) dispersing agent.

15. The composition of any one of the preceding claims, the composition further comprising an aqueous medium.

16. The composition of any one of the preceding claims, wherein the amount of the phase change material is from 1.0 wt% to 99.0 wt% with respect to the weight of the composition.

17. The composition of any one of the preceding claims, wherein the amount of the electrospun carbon fiber is from 0.1 wt% to 50.0 wt% with respect to the weight of the composition.

18. The composition of any one of the preceding claims, wherein the amount of the one or more additives is from 0.01 wt% to 40.0 wt% with respect to the weight of the composition.

19. The composition of any one of the preceding claims, wherein the amount of the aqueous medium is from 70.0 wt% to 90.0 wt% with respect to the weight of the composition.

20. The composition of any one of the preceding claims, wherein the composition has one or more of the following properties: degradation

temperature of from 55.0°C to 75.0°C; melting temperature of from -20.0°C to -5.0°C; and melting latent heat of from 100.0 J/g to 300.0 J/g.

21. A method of preparing the composition of any one of the preceding claims, the method comprising:
    (i) providing electrospun carbon fiber;
    (ii) providing phase change material (PCM);
    (iii) optionally providing one or more additives; and
    (iv) mixing said carbon fiber with phase change material (PCM) and optionally one or more additives under suitable conditions to obtain a composition in the form of a fluid.

22. The method of claim 21, wherein the method further comprises, prior to the step of providing electrospun carbon fiber,
    (a-i) providing a polymer solution;
    (a-ii) optionally adding metal precursor to the polymer solution;
    (a-iii) extruding the polymer solution from a spinneret into fiber;
    (a-iv) stabilizing the extruded fiber to obtain stabilized fiber; and
    (a-v) carbonizing the stabilized fiber to obtain the electrospun carbon fiber.

23. The method of claim 22, wherein the polymer solution comprises synthetic and/or natural polymers.

24. The method of claim 23, wherein the polymer solution is selected from the group consisting of polyacrylonitrile (PAN), lignin, poly(vinyl alcohol) (PVA), poly(ethylene oxide) (PEO) or poly(ethylene glycol) (PEG), cellulose acetate, poly(ethylene terephthalate) (PETE), polyvinylpyrrolidone (PVP), polylactic acid (PLA), polycaprolactone (PCL), polyvinylidene fluoride (PVDF), polyurethane (PU), cellulose, polyacrylate, polyamide and combinations thereof.

25. The method of claim 24, wherein the polymer solution further comprises metal precursor selected from the group consisting of metal chloride, metal fluoride, metal bromide, metal iodide, metal sulfate, metal sulfide, metal cyanide, metal thiocyanate, metal acetylide, metal acetate, metal hydroxide, metal hydride, metal nitrate, metal phosphide, metal phosphate, metal carbonate, metal carbonate hydroxide, metal chlorate, metal arsenate, metal azide, metal acetylacetonate, metal perchlorate, metal triflate, metal tetrafluoroborate, metal benzoate, metal chromite, metal peroxide and combinations thereof.

26. Use of a composition of any one of claims 1-20 in maintaining an environment at a sub-zero temperature range.