CLAIMS

What is claimed is:

1. An article, comprising:

a self-supporting composite having a thickness of between 10 micrometers and 1 mm, the composite comprising a solid phase material and a phase change material, the solid phase material comprising an open pore volume of less than 90 vol%, the phase change material comprising a metal, a metal oxide, a metal alloy, or combination thereof,

wherein the phase change material exhibits a melt temperature of between 10 ºC and 65 ºC, and wherein the composite has a thermal impedance of less than 10 $mm^2$ K/W at 10 ºC above the melt temperature, wherein the thermal impedance is determined under 206.8 kPa (30 psi) pressure when tested using an ASTM D5470 Test capable fixture.

2. An article, comprising:

a self-supporting composite having a thickness of between 200 micrometers and 1 mm, the composite comprising a solid phase material and a phase change material, the solid phase material comprising an open pore volume of less than 90 vol%, the phase change material comprising a metal, a metal oxide, a metal alloy, or combination thereof,

wherein the phase change material exhibits a melt temperature of between 10 ºC and 65 ºC, and wherein the composite has a thermal impedance of less than 10 $mm^2$ K/W at 10 ºC above the melt temperature, wherein the thermal impedance is determined under 206.8 kPa (30 psi) pressure when tested using an ASTM D5470 Test capable fixture.

3. An article, comprising:

a self-supporting composite having a thickness of between 10 micrometers and 1 mm, the composite comprising a solid phase material and a phase change material that do not chemically react with each other, the composite being free of flux, the solid phase material comprising an open pore volume of less than 90 vol%, the phase change material comprising a metal, a metal oxide, a metal alloy, or combination thereof,

wherein the phase change material exhibits a melt temperature of between 10 ºC and 65 ºC, and wherein the composite has a thermal impedance of less than 10 $mm^2$ K/W at 10 ºC above the melt temperature, and wherein the composite comprises a thermal impedance within 2 $mm^2$K/W of the thermal impedance after 1000 hours at a temperature of 5 ºC above the melt temperature, wherein the thermal impedance is determined under 206.8 kPa (30 psi) pressure when tested using an ASTM D5470 Test capable fixture.

4. The article of any one of claims 1-3, wherein the phase change material comprises gallium.

5. The article of any one of claims 1-4, wherein the phase change material comprises indium.

6. The article of any one of claims 1-5, wherein the solid phase material comprises metal foam.

7. The article of claim 6, wherein the metal foam comprises a non-reactive metal.

8. The article of claim 7, wherein the non-reactive metal comprises titanium.

9. The article of claim 6, wherein the metal foam comprises a reactive metal.

10. The article of claim 9, wherein the reactive metals comprise copper.

11. The article of claim 9, wherein the reactive metal comprises iron.

12. The article of any one of claims 1-11, wherein the solid phase material is adjacent to a layer that prevents a chemical reaction with the solid phase material.

13. The article of claim 12, wherein the chemical reaction is an oxidation-reduction reaction.

14. The article of any one of claims 1-13, wherein the solid phase material comprises fibers.

15. The article of any one of claims 1-14, wherein the solid phase material comprises a porous metallic solid.

16. The article of any one of claims 1-15, wherein the solid phase material comprises passivated metallic particles.

17. The article of any one of claims 1-16, wherein the solid phase material comprises carbon foam.

18. The article of any one of claims 1-17, wherein the solid phase material comprises carbon paper.

19. The article of any one of claims 1-18, wherein the solid phase material comprises carbon-based particles.

20. The article of claim 19, wherein the carbon-based particles comprise graphite.

21. The article of any one of claims 19 or 20, wherein the carbon-based particles comprise graphene.

22. The article of any one of claims 19-21, wherein the carbon-based particles comprise carbon fibers.

23. The article of any one of claims 19-22, wherein the carbon-based particles comprise carbon nanotubes.

24. The article of any one of claims 1-23, wherein the solid phase material comprises ceramic particles.

25. The article of claim 24, wherein the ceramic particles comprise iron oxide.

26. The article of any one of claims 1-25, wherein the self-supporting composite can be handled without a support at a temperature of no more than 40 °C.

27. The article of any one of claims 1-26, wherein the phase change material forms a continuous outer surface of the composite.

28. A method for fabricating the article of any one of claims 1-27, comprising forming a composite by mechanical mixing the phase change material and the solid phase material.