What is claimed:

1) A method comprising:

a) Providing a precursor solution comprising silica gel precursor materials and a solvent;

b) Combining the precursor solution with a reinforcement material;

~~b)~~c) Allowing the silica gel precursor materials in the precursor solution to transition into a gel composition to form a reinforced, silica-based gel composition;

~~c)~~d) Extracting at least a portion of ~~the~~ a solvent from the reinforced, silica-based gel composition to obtain a first reinforced, silica-based aerogel composition; and

~~d)~~e) Exposing the first reinforced, silica-based aerogel composition to one or more heat treatments in a reduced oxygen atmosphere at a temperature above 300° C to obtain a second reinforced, silica-based aerogel composition;

wherein the method further comprises incorporating at least one hydrophobic-bound silicon into the first reinforced, silica-based aerogel composition prior to step ~~d~~e).

~~2) The method of claim 1, wherein the method further comprises incorporating a reinforcement material into the first aerogel composition.~~

~~3) The method of claim 2, wherein the reinforcement material comprises a sheet of fiber reinforcement material.~~

~~4) The method of any one of claims 1-3, wherein the first aerogel composition is exposed to the reduced oxygen atmosphere at temperatures between 400° C and 700° C for a period of time between about 30 seconds and about 200 minutes.~~

~~5) The method of any one of claims 1-4, wherein the temperature exposure in the treatment of the first aerogel composition is limited to a temperature below 850°C.~~

~~6) The method of any one of claims 1-5, wherein the reduced oxygen atmosphere comprises 0.1% to 5% oxygen by volume.~~

~~7) The method of any one of claims 1-6, wherein the second aerogel composition has a hydrophobic organic content between 1 wt% and 25 wt%.~~

~~8) The method of any one of claims 1-7, wherein at least 50% of the hydrophobic organic material in the second aerogel composition comprises aliphatic hydrophobic groups.~~

~~9) The method of any one of claims 1-8, wherein the hydrophobic-bound silicon is incorporated into the first aerogel composition by including in the precursor solution at least one silica gel precursor material having at least one hydrophobic group.~~

~~10) The method of any one of claims 1-9, wherein the hydrophobic-bound silicon is incorporated into the first aerogel composition by exposing the gel or first aerogel composition to a hydrophobizing agent.~~

~~11~~2) A method comprising exposing a first reinforced, silica-based aerogel composition comprising at least one hydrophobic-bound silicon to one or more heat treatments in a reduced oxygen atmosphere at a temperature above 300° C to obtain a second reinforced, silica-based aerogel composition; wherein the second reinforced, silica-based aerogel

composition has the following properties: i) liquid water uptake of 40 wt% or less; and ii) an onset of thermal decomposition of hydrophobic organic materials of 500°C or more.

3) The method of claim 2, wherein the second reinforced, silica-based aerogel composition has the following property: iii) heat of combustion of 717 cal/g or less; and iv) thermal conductivity of between 15 mW/M*K and 40 mW/M*K.

~~12) The method of any one of claims 1-11, wherein the first aerogel composition is a reinforced aerogel composition comprising a reinforcement material.~~

~~13~~4) The method of any one of claims 1-~~12~~3, wherein the second reinforced, silica-based aerogel composition ~~reinforcement material~~ comprises a sheet of fiber reinforcement material.

~~14) The method of any one of claims 1-13, wherein the first aerogel composition is exposed to the reduced oxygen atmosphere at temperatures between 300° C and 700° C for a period of time between about 30 seconds and about 200 minutes.~~

~~1~~5) The method of any one of claims 1-~~14~~, wherein ~~the temperature exposure of the~~ any heat treatment in a reduced oxygen atmosphere of any aerogel composition is limited to a temperature below ~~850~~700°C.

~~16) The method of any one of claims 1-15, wherein the reduced oxygen atmosphere comprises 0.1% to 5% oxygen by volume.~~

~~17~~6) The method of any one of claims 1-~~16~~5, wherein the second reinforced, silica-based aerogel composition has a hydrophobic organic content between 1 wt% and ~~25~~ 15 wt%.

~~18) The method of any one of claims 1-17, wherein at least 50% of the hydrophobic organic material in the second aerogel composition comprises aliphatic hydrophobic groups.~~

~~19~~7) The method of any one of claims 1-~~18~~6, wherein the second reinforced, silica-based aerogel composition has a lower liquid water uptake ~~percentage~~ relative to the first reinforced, silica-based aerogel composition.

8) The method of any one of claims 1-7, wherein the second reinforced, silica-based aerogel composition has liquid water uptake of 40 wt% or less; and has one or more of the following properties: ii) onset of thermal decomposition of hydrophobic organic materials between 500°C and 635°C, or iii) heat of combustion between 265 cal/g and 717 cal/g.

9) The method of any one of claims 1-7, wherein the second reinforced, silica-based aerogel composition has liquid water uptake of 40 wt% or less; and one or more of the following properties: ii) onset of thermal decomposition of hydrophobic organic materials between 525°C and 635°C, or iii) heat of combustion between 265 cal/g and 600 cal/g.

10) The method of any one of claims 1-7, wherein the second reinforced, silica-based aerogel composition has liquid water uptake of 40 wt% or less; and one or more of the following properties: ii) onset of thermal decomposition of hydrophobic organic materials between 550°C and 635°C, or iii) heat of combustion between 265 cal/g and 550 cal/g.

11) The method of any one of claims 1-7, wherein the second reinforced, silica-based aerogel composition has liquid water uptake of 40 wt% or less; and one or more of the following properties: ii) onset of thermal decomposition of hydrophobic organic materials between 575°C and 635°C, or iii) heat of combustion between 265 cal/g and 500 cal/g.

~~20) The method of any one of claims 1-19, wherein the second aerogel composition has a lower heat of combustion relative to the first aerogel composition.~~

~~21) The method of any one of claims 1-20, wherein the second aerogel composition has a higher onset of thermal decomposition temperature relative to the first aerogel composition.~~

~~2~~12) An aerogel composition produced by the method of any one of claims 1-~~21~~11.

~~23) The aerogel composition of claim 22; wherein the aerogel composition has the following properties:~~

~~a) density of 0.60 g/cm3 or less;~~
~~b) thermal conductivity of 50 mW/M*K or less;~~
~~c) liquid water uptake of 40 wt% or less;~~
~~d) heat of combustion of less than 717 cal/g; and~~
~~e) onset of thermal decomposition of hydrophobic organic materials of 300°C or higher.~~

~~24) The aerogel composition of claim 22; wherein the aerogel composition has the following properties:~~

~~a) density of 0.40 g/cm3 or less;~~
~~b) thermal conductivity of 30 mW/M*K or less;~~
~~c) liquid water uptake of 40 wt% or less;~~
~~d) heat of combustion of less than 600 cal/g; and~~
~~e) onset of thermal decomposition of hydrophobic organic materials of 525°C or higher.~~

~~25) The aerogel composition of any one of claims 22-24, wherein the hydrophobic organic content in the aerogel composition is between 1 wt% and 25 wt%.~~

~~26) The aerogel composition of any one of claims 22-25, wherein the aerogel composition has a ratio of T^{1-2}:T^{3} of between 0.01 and 0.4.~~

~~27~~13) A~~n~~ reinforced aerogel composition comprising a silica-based framework; wherein the reinforced aerogel composition has the following properties:
~~a) density of 0.60 g/cm3 or less;~~
~~b) thermal conductivity of 50 mW/M*K or less;~~
~~c~~i) liquid water uptake of 40 wt% or less;
~~d) heat of combustion of less than 717 cal/g;~~ and
~~e~~ii) onset of thermal decomposition of hydrophobic organic materials of ~~300~~500°C or higher.

14) The reinforced aerogel composition of claim 13, wherein the reinforced aerogel composition has the following property: iii) heat of combustion of 717 cal/g or less.

~~28) The aerogel composition of any one of claims 22-27, wherein the aerogel composition is a reinforced aerogel composition comprising a reinforcement material.~~

~~29~~15) The reinforced aerogel composition of any one of claims ~~22-28~~13-14, wherein the reinforced aerogel composition ~~reinforcement material~~ comprises a sheet of fiber reinforcement material.

16) The reinforced aerogel composition of any one of claims 13-15, wherein the reinforced aerogel composition has the following properties: i) liquid water uptake of 40 wt% or less; ii) onset of thermal decomposition of hydrophobic organic materials between 500°C and 635°C; iii) heat of combustion between 265 cal/g and 717 cal/g; and iv) thermal conductivity of between 15 mW/M*K and 40 mW/M*K.

17) The reinforced aerogel composition of any one of claims 13-16, wherein the reinforced aerogel composition has one or more of the following properties: ii) onset of thermal decomposition of hydrophobic organic materials between 525°C and 635°C; or iii) heat of combustion between 265 cal/g and 600 cal/g.

18) The reinforced aerogel composition of any one of claims 13-16, wherein the reinforced aerogel composition has one or more of the following properties: ii) onset of thermal decomposition of hydrophobic organic materials between 550°C and 635°C; or iii) heat of combustion between 265 cal/g and 550 cal/g.

19) The reinforced aerogel composition of any one of claims 13-16, wherein the reinforced aerogel composition has one or more of the following properties: ii) onset of thermal decomposition of hydrophobic organic materials between 575°C and 635°C; or iii) heat of combustion between 265 cal/g and 500 cal/g.

~~30) The aerogel composition of any one of claims 22-29, wherein the aerogel composition has a density of 0.40 g/cm3 or less.~~

~~31) The aerogel composition of any one of claims 22-30, wherein the aerogel composition has a thermal conductivity of 30 mW/M*K or less.~~

~~32) The aerogel composition of any one of claims 22-31, wherein the aerogel composition has a heat of combustion of less than 600 cal/g.~~

~~33) The aerogel composition of any one of claims 22-32, wherein the aerogel composition has a heat of combustion of 550 cal/g or less.~~

~~34) The aerogel composition of any one of claims 22-33, wherein the aerogel composition has a heat of combustion of 500 cal/g or less.~~

~~35) The aerogel composition of any one of claims 22-34, wherein the aerogel composition has a heat of combustion between 250 cal/g and 600 cal/g.~~

~~36) The aerogel composition of any one of claims 22-35, wherein the aerogel composition has an onset of thermal decomposition of hydrophobic organic materials of 500°C or higher.~~

~~37) The aerogel composition of any one of claims 22-36, wherein the aerogel composition has an onset of thermal decomposition of hydrophobic organic materials of 525°C or higher.~~

~~38) The aerogel composition of any one of claims 22-37, wherein the aerogel composition has an onset of thermal decomposition of hydrophobic organic materials of 575°C or higher.~~

~~39) The aerogel composition of any one of claims 22-38, wherein the aerogel composition has an onset of thermal decomposition of hydrophobic organic materials of 600°C or higher.~~

~~40) The aerogel composition of any one of claims 22-39, wherein the aerogel composition has an onset of thermal decomposition of hydrophobic organic materials between 525°C and 650°C.~~

~~41~~20) The reinforced aerogel composition of any one of claims ~~22-40~~13-19, wherein the hydrophobic organic content in the reinforced aerogel composition is between about 1 wt% and about ~~25~~ 15 wt%.

~~42) The aerogel composition of any one of claims 22-41, wherein the hydrophobic organic content in the aerogel composition is between about 1 wt% and about 15 wt%.~~

~~43) The aerogel composition of any one of claims 22-42, wherein at least 50 wt% of the hydrophobic organic content in the aerogel composition comprises aliphatic hydrophobic groups.~~

~~44) The aerogel composition of any one of claims 22-43, wherein the aerogel composition has a ratio of T^{1-2}:T^{3} of between about 0.01 and 0.4.~~

~~45) The aerogel composition of any one of claims 22-44, wherein the aerogel composition has a ratio of Q^{1-3}:Q^{4} of between about 0.1 and 1.5.~~

~~46) An aerogel composition comprising a silica-based framework; wherein the aerogel composition has the following properties:~~

~~a) liquid water uptake of 40 wt% or less; and~~

~~b) heat of combustion of less than 717 cal/g.~~

~~47) The aerogel composition of any one of claims 22-46, wherein the aerogel composition is a reinforced aerogel composition comprising a reinforcement material.~~

~~48) The aerogel composition of any one of claims 22-47, wherein the aerogel composition has a heat of combustion of less than 600 cal/g.~~

~~49) The aerogel composition of any one of claims 22-48, wherein the aerogel composition has a heat of combustion between 250 cal/g and 600 cal/g.~~

~~50) The aerogel composition of any one of claims 22-49, wherein the hydrophobic organic content in the aerogel composition is between 1 wt% and 25 wt%.~~

~~51) The aerogel composition of any one of claims 22-50, wherein the aerogel composition has a ratio of T^{1-2}:T^{3} of between 0.01 and 0.4.~~

~~52) An aerogel composition comprising a silica-based framework; wherein the aerogel composition has the following properties:~~

a) liquid water uptake of 40 wt% or less; and
b) onset of thermal decomposition of hydrophobic organic materials of 300°C or higher.

53) The aerogel composition of any one of claims 22-52, wherein the aerogel composition is a reinforced aerogel composition comprising a reinforcement material.

54) The aerogel composition of any one of claims 22-53, wherein the aerogel composition has an onset of thermal decomposition of hydrophobic organic materials of 525°C or higher.

55) The aerogel composition of any one of claims 22-54, wherein the aerogel composition has an onset of thermal decomposition of hydrophobic organic materials between 525°C and 650°C.

56) The aerogel composition of any one of claims 22-55, wherein the hydrophobic organic content in the aerogel composition is between 1 wt% and 25 wt%.

57) The aerogel composition of any one of claims 22-56, wherein the aerogel composition has a ratio of T^{1-2}:T^{3} of between 0.01 and 0.4.