

What is claimed is:

1. A reinforced aerogel composition comprising a silica-based aerogel framework, reinforced with an OCMF material, and a fire-class additive; wherein the silica-based aerogel framework comprises at least one hydrophobic-bound silicon; and wherein the reinforced aerogel composition has the following properties:
 - i) liquid water uptake of 20 wt% or less;
 - ii) thermal conductivity of 30 mW/M*K or less according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression load of about 2 psi; and
 - iii) heat of combustion of less than 717 cal/g according to EN ISO 1716 standard.
2. A reinforced aerogel composition comprising a silica-based aerogel framework, reinforced with an OCMF material with a density of between 2 kg/m³ and 25 kg/m³, and a fire-class additive; wherein the silica-based aerogel framework comprises at least one hydrophobic-bound silicon; and wherein the reinforced aerogel composition has the following properties:
 - i) liquid water uptake of 20 wt% or less;
 - ii) thermal conductivity of 30 mW/M*K or less according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression load of about 2 psi; and
 - iii) heat of combustion of less than 717 cal/g according to EN ISO 1716 standard.
3. A reinforced aerogel composition comprising a silica-based aerogel framework, reinforced with an OCMF material with a density of 2 kg/m³ and

25 kg/m³, and a fire-class additive; wherein the silica-based aerogel framework comprises at least one hydrophobic-bound silicon; and wherein the reinforced aerogel composition has the following properties:

- i) liquid water uptake of between 1 wt% and 10 wt%;
- ii) thermal conductivity of more than 8 and less than 25 mW/M*K according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression load of about 2 psi; and
- iii) heat of combustion of less than 717 cal/g and more than 400 cal/g according to EN ISO 1716 standard.

4. A reinforced OCMF composition reinforced with a silica-based aerogel composition and a fire-class additive; wherein the silica-based aerogel framework comprises at least one hydrophobic-bound silicon; and wherein the reinforced aerogel composition has the following properties:

- i) liquid water uptake of 20 wt% or less;
- ii) thermal conductivity of 30 mW/M*K or less according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression load of about 2 psi; and
- iii) heat of combustion of less than 717 cal/g according to EN ISO 1716 standard.

5. A reinforced OCMF composition reinforced with a silica-based aerogel composition and a fire-class additive; wherein the silica-based aerogel framework comprises at least one hydrophobic-bound silicon; and wherein the reinforced aerogel composition has the following properties:

- i) liquid water uptake of 20 wt% or less;

- ii) thermal conductivity of 30 mW/M*K or less according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression of about 2 psi; and
 - iii) heat of combustion of less than 717 cal/g according to EN ISO 1716 standard.
- 6. A reinforced OCMF composition reinforced with a silica-based aerogel composition and a fire-class additive; wherein the silica-based aerogel framework comprises at least one hydrophobic-bound silicon; and wherein the reinforced aerogel composition has the following properties:
 - i) liquid water uptake of between 1 wt% and 10 wt%;
 - ii) thermal conductivity of more than 8 and less than 25 mW/M*K according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression of about 2 psi; and
 - iii) heat of combustion of less than 717 cal/g and more than 400 cal/g according to EN ISO 1716 standard.
- 7. The reinforced aerogel composition of any one of claim 1-3 or reinforced OCMF composition of any one of claims 4-6, wherein the OCMF material comprises or is an organic OCMF material.
- 8. The reinforced aerogel composition of any one of claim 1-3 or reinforced OCMF composition of any one of claims 4-7, wherein the OCMF material comprises or is a melamine based OCMF material.

9. The reinforced aerogel composition of any one of claim 1-3 or reinforced OCMF composition of any one of claims 4-6, wherein the OCMF material comprises or is a sheet of OCMF material.
10. The reinforced aerogel composition of any one of claim 1-3 or reinforced OCMF composition of any one of claims 4-9, wherein the OCMF material is an organic foam.
11. The reinforced aerogel composition of any one of claim 1-3 or reinforced OCMF composition of any one of claims 4-6, wherein the OCMF material is a melamine based foam.
12. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-11, wherein the OCMF material is neither a low-combustible material nor a non-combustible material.
13. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-11, wherein the OCMF material is neither a low-flammable material nor a non-flammable material.
14. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-11, wherein the OCMF material comprises between 2 wt% and 10 wt% of the composition.
15. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-14, wherein the hydrophobic silicon-bound content in the composition is between 2 wt% and 10 wt%.

16. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-14, wherein the hydrophobic silicon-bound content in the composition is between 2 wt% and 8 wt%.
17. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-14, wherein the hydrophobic silicon-bound content in the composition is between 2 wt% and 6 wt%.
18. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-17, wherein the composition has a heat of combustion of 700 cal/g or less according to EN ISO 1716 standard.
19. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-17, wherein the composition has a heat of combustion of 675 cal/g or less according to EN ISO 1716 standard.
20. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-17, wherein the composition has a heat of combustion of 650 cal/g or less according to EN ISO 1716 standard.
21. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-17, wherein the composition has a heat of combustion of 625 cal/g or less according to EN ISO 1716 standard.

22. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the composition has a thermal conductivity of 22 mW/M*K or less according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression load of about 2 psi.
23. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the reinforced aerogel composition has a thermal conductivity of 20 mW/M*K or less according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression load of about 2 psi.
24. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the reinforced aerogel composition has a thermal conductivity of 18 mW/M*K or less according to ASTM C518 standard at a temperature of about 37.5 °C, in an ambient environment, at atmospheric pressure, and at a compression load of about 2 psi.
25. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the reinforced aerogel composition has a density between 0.15 and 0.40 g/cm³.
26. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the reinforced aerogel composition has an onset of thermal decomposition of organic content of 350°C or above.

27. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the reinforced aerogel composition has an onset of thermal decomposition of 360°C or above.
28. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the reinforced aerogel composition has an onset of thermal decomposition of 370°C or above.
29. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the reinforced aerogel composition has an onset of thermal decomposition of 380°C or above.
30. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-21, wherein the reinforced aerogel composition has an onset of thermal decomposition of 390°C or above.
31. An organic OCMF reinforced aerogel composition comprising fire-class additives and hydrophobic organic content wherein, , the onset of endothermic decomposition of the fire-class additives in the composition is within 50°C of the onset of thermal decomposition of the rest of the composition without the fire-class additive.
32. An organic OCMF reinforced aerogel composition comprising fire-class additives and hydrophobic content of at least 5%, , wherein the total heat of endothermic decomposition of the fire-class additives in the composition is at least 30% of the exothermic heat of decomposition of the rest of the composition without the fire-class additive,.

33. An organic OCMF reinforced aerogel composition comprising at least two fire-class additives with their respective onset of endothermic decomposition are at least 10°C apart.
34. An organic OCMF reinforced aerogel composition comprising fire-class additives and hydrophobic content wherein the total heat of endothermic decomposition of the fire-class additives in the composition is no more than 80% of the exothermic heat of decomposition of the rest of the composition without the fire-class additive.
35. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-11, wherein the hydrophobic content is at least 5%, , and the total heat of endothermic decomposition of the fire-class additives in the composition is at least 30% of the exothermic heat of decomposition of the rest of the composition without the fire-class additive,.
36. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-11, wherein, , the onset of endothermic decomposition of the fire-class additives in the composition is within 50°C of the onset of thermal decomposition of the rest of the composition without the fire-class additive.
37. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-11, with at least two fire-class additives wherein the two fire-class additives respective onset of endothermic decomposition are at least 10°C apart

38. The reinforced aerogel composition or reinforced OCMF composition of any one of claims 1-11, wherein the total heat of endothermic decomposition of the fire-class additives in the composition is no more than 80% of the exothermic heat of decomposition of the rest of the composition without the fire-class additive.
39. The composition of any one of claims 1-38, wherein the furnace temperature rise of the composition in accordance with ISO 1182 is about 100 °C or less, about 90 °C or less, about 80 °C or less, about 70 °C or less, about 60 °C or less, about 50 °C or less, about 45 °C or less, about 40 °C or less, about 38 °C or less, about 36 °C or less, about 34 °C or less, about 32 °C or less, about 30 °C or less, about 28 °C or less, about 26 °C or less, about 24 °C or less, or in a range between any two of these values.
40. The composition of any one of claims 1-39, wherein the flame time of the composition in accordance with ISO 1182 is about 30 seconds or less, about 25 seconds or less, about 20 seconds or less, about 15 seconds or less, about 10 seconds or less, about 5 seconds or less, about 2 seconds or less, or in a range between any two of these values.
41. The composition of any one of claims 1-40, wherein the mass loss of the composition in accordance with ISO 1182 is about 50% or less, about 40% or less, about 30% or less, about 28% or less, about 26% or less, about 24% or less, about 22% or less, about 20% or less, about 18% or less, about 16% or less, or in a range between any two of these values.
42. The composition of any one of the above claims, wherein the composition is low-flammable.

43. The composition of any one of the above claims, wherein the composition is non-flammable.
44. The composition of any one of the above claims, wherein the composition is low-combustible.
45. The composition of any one of the above claims, wherein the composition is non-combustible.
46. The composition of any one of the above claims, wherein, , the onset of endothermic decomposition of the fire-class additive is greater than 280°C, 300°C, 350°C, 400°C, 450°C, or 500°C.
47. The composition of any one of the above claims, wherein the onset of exothermic decomposition of organic content of the composition without the fire-class additive is greater than 280°C, 300°C, 350°C, 400°C, 450°C, or 500°C,.
48. The composition of any one of the above claims, wherein the OCMF material is a melamine-based foam.
49. The composition of any one of the above claims, wherein the OCMF material is a urethane-based polymer foam.

50. The composition of any one of the above claims, wherein the OCMF material is a reticulated foam.