

CLAIMS

1. A method for manufacturing water-based hydrophobic aerogels and aerogel composites, the method comprising:
- 5 synthesizing an aqueous binder mixture;
adding silyl modified precursors to form an emulsion;
forming a gelled composite under vacuum homogenizing conditions;
treating the gelled composite hydrophobically;
freezing the gelled composite;
10 microwave assisted vacuum freeze-drying the gelled composite to form an aerogel composite;
and
curing the aerogel composite,
wherein the microwave assisted vacuum freeze drying is configured to induce bulk drying of the gelled composite.
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2. The method of claim 1, wherein the aqueous mixture includes fire retardants, inorganic fillers, surfactants and a strengthening agent.
3. The method of either claim 1 or 2, wherein the microwave assisted vacuum freeze-drying is carried out using a microwave assisted vacuum freeze dryer.
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4. The method of any of claims 1 to 3, wherein the silyl modified precursors are prepared from a process selected from a group consisting of: sol-gel techniques, emulsion techniques, and phase transfer techniques.
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5. The method of any of claims 1 to 4, wherein the hydrophobic treatment is carried out in-situ under vacuum conditions.
6. The method of any of claims 1 to 5, further including an infused step, wherein the infused step includes adding a water based hydrophobic material.
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7. The method of any of claims 1 to 6, wherein the gelled composite is formed by adding a water soluble crosslinking agent.
8. A water-based hydrophobic aerogels and aerogel composites manufactured by a method comprising:
- 35 synthesizing an aqueous binder mixture;
adding silyl modified precursors to form an emulsion;
forming a gelled composite under vacuum homogenizing conditions;
40 treating the gelled composite hydrophobically;
freezing the gelled composite;
microwave assisted vacuum freeze-drying the gelled composite to form an aerogel composite;
and
curing the aerogel composite,

wherein the microwave assisted vacuum freeze-drying is configured to induce bulk drying of the gelled composite.

5 9. The water-based hydrophobic aerogels and aerogel composites of claim 8, wherein the aqueous mixture includes fire retardants, inorganic fillers, surfactants and a strengthening agent.

10 10. The water-based hydrophobic aerogels and aerogel composites of either claim 8 or 9, wherein the microwave assisted vacuum freeze-drying is carried out using a microwave assisted vacuum freeze dryer.

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11. The water-based hydrophobic aerogels and aerogel composite of any of claims 8 to 10, wherein the silyl modified precursors are prepared from a process selected from a group consisting of: sol-gel techniques, emulsion techniques, and phase transfer techniques.

15 12. The water-based hydrophobic aerogels and aerogel composite of any of claims 8 to 11, wherein the hydrophobic treatment is carried out in-situ under vacuum conditions.

20 13. The water-based hydrophobic aerogels and aerogel composite of any of claims 8 to 12, wherein the method further including an infused step, wherein the infused step includes adding a water based hydrophobic material.

14. The water-based hydrophobic aerogels and aerogel composite of any of claims 8 to 13, wherein the gelled composite is formed by adding a water soluble crosslinking agent.

25 15. A water based hydrophobic aerogel composite comprising:
a silyl modified aerogel precursor system;
a surfactant;
fire retardants;
hydrophobic agent; and
30 a crosslinking agent,
wherein the components are homogeneously distributed, and being fabricated by the method of any of claims 1 to 7.

35 16. The aerogel composite of claim 15, being formed in a manner which exhibits minimal shrinkage and densification.

17. The aerogel composite of either claim 15 or 16, wherein the silyl modified aerogel precursor system is at least one selected from a group consisting of: silica, polysaccharide and a water-based polymers.

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