CLAIMS

1. A method for manufacturing water-based hydrophobic aerogels and aerogel composites, the method comprising:
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 in-situ under vacuum conditions;
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.

2. The method of claim 1, wherein the aqueous mixture includes fire retardants, inorganic fillers, surfactants and a strengthening agent.

3. The method of claim 1, wherein the microwave assisted vacuum freeze-drying is carried out using a microwave assisted vacuum freeze dryer.

4. The method of claim 1, 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.

5. The method of claim 1, further including an infused step, wherein the infused step includes adding a water based hydrophobic material.

6. The method of claim 1, wherein the gelled composite is formed by adding a water soluble crosslinking agent.

7. A water-based hydrophobic aerogels and aerogel composites manufactured by a method comprising:
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 in-situ under vacuum conditions;
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.

8. The water-based hydrophobic aerogels and aerogel composites of claim 7, wherein the aqueous mixture includes fire retardants, inorganic fillers, surfactants and a strengthening agent.

9. The water-based hydrophobic aerogels and aerogel composites of claim 7, wherein the microwave assisted vacuum freeze-drying is carried out using a microwave assisted vacuum freeze dryer.

10. The water-based hydrophobic aerogels and aerogel composite of claim 7, 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.

11. The water-based hydrophobic aerogels and aerogel composite of claim 7, wherein the method further including an infused step, wherein the infused step includes adding a water based hydrophobic material.

12. The water-based hydrophobic aerogels and aerogel composite of claim 7, wherein the gelled composite is formed by adding a water soluble crosslinking agent.

13. A water based hydrophobic aerogel composite comprising:
a silyl modified aerogel precursor system;
a surfactant;
fire retardants;
hydrophobic agent; and
a crosslinking agent,
wherein the components are homogeneously distributed, and being fabricated by the method of claim 1.

14. The aerogel composite of claim 13, being formed in a manner which exhibits minimal shrinkage and densification.

15. The aerogel composite of claim 13, wherein the silyl modified aerogel precursor system is at least one selected from a group consisting of: silica, polysaccharide and a water-based polymers.