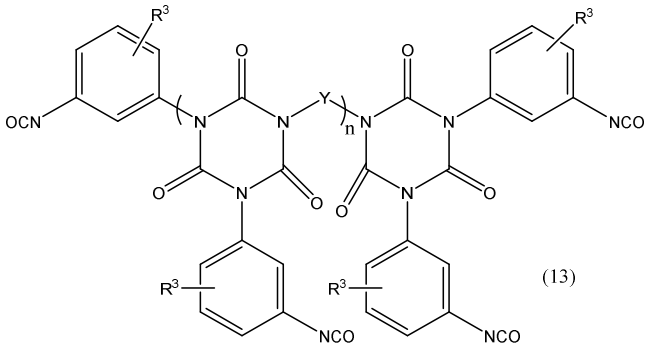
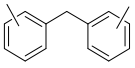
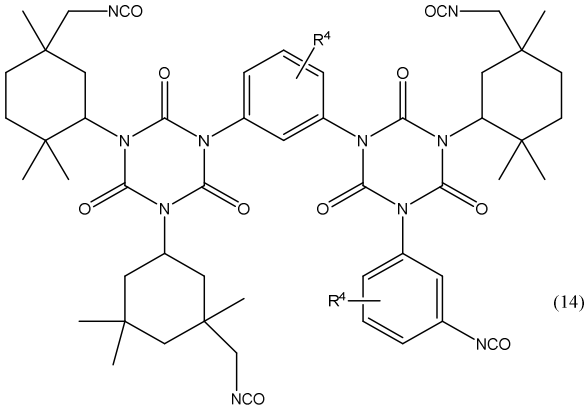


(13)

wherein R^3 is selected independently from the group consisting of alkyl, hydrogen and alkenyl, and Y is selected from the group consisting of  and , and n is an integer from 0 to 3;



(14)

wherein R^4 is selected independently from the group consisting of alkyl, hydrogen and alkenyl.

The present invention also relates to a method for preparing an aerogel according to the present invention comprising the steps of: 1) adding a clay into a solvent and mixing at high shear rates; 2) adding an isocyanate and mixing; 3) adding a catalyst if present, and mixing; 4) letting the mixture to stand in order to form a gel; 5) washing said gel with a solvent; and 6) drying said gel by supercritical drying or ambient drying.

The present invention encompasses a thermal or an acoustic insulating material comprising a hybrid aerogel according to the present invention.

In addition, the present invention encompasses the use of a hybrid aerogel according to the present invention as a thermal or acoustic insulating material.

In one aspect, there is provided an aerogel obtained by reacting an isocyanate compound and silanol moieties on a surface of a clay in a presence of a solvent, wherein said isocyanate is selected from the group consisting of 1,3,5-Tris(6-isocyanatohexyl)-1,3,5-triazinane-2,4,6-trione, 6-[3-(6-isocyanatohexyl)-2,4-dioxo-1,3-diazetidin-1-yl]hexyl N-(6-isocyanatohexyl) carbamate, methylene diphenyl diisocyanate, 1,6-diisocyanatohexane, 1-[bis(4-isocyanatophenyl)methyl]-4-

isocyanatobenzene, 2,4-diisocyanato-1-methyl-benzene, oligomers of the above-mentioned and mixtures thereof.

In another aspect, there is provided a method for preparing an aerogel as described herein comprising the steps of: 1) adding a clay into a solvent and mixing at a stirring rate of greater than 1500 rpm; 2) adding an isocyanate and mixing; 3) adding a catalyst if present, and mixing; 4) letting the mixture to stand in order to form a gel; 5) washing said gel with a solvent; and 6) drying said gel by supercritical drying or ambient drying.

In yet another aspect, there is provided a thermal or an acoustic insulating material comprising a hybrid aerogel as described herein.

In another aspect, there is provided the use of a hybrid aerogel as described herein as a thermal or acoustic insulating material.

Short description of the figures

Figure 1 illustrates a basic principle of the reaction between the isocyanate compound and silanol moieties to obtain a hybrid aerogel according to the present invention.

Figure 2 illustrates a structure of an organoclay.

Claims

1. An aerogel obtained by reacting an isocyanate compound and silanol moieties on a surface of a clay in a presence of a solvent, wherein said isocyanate is selected from the group consisting of 1,3,5-Tris(6-isocyanatohexyl)-1,3,5-triazinane-2,4,6-trione, 6-[3-(6-isocyanatohexyl)-2,4-dioxo-1,3-diazetidin-1-yl]hexyl N-(6-isocyanatohexyl) carbamate, methylene diphenyl diisocyanate, 1,6-diisocyanatohexane, 1-[bis(4-isocyanatophenyl)methyl]-4-isocyanatobenzene, 2,4-diisocyanato-1-methyl-benzene, oligomers of the above-mentioned and mixtures thereof.

2. An aerogel according to claim 1, wherein said isocyanate compound and said clay are reacted in the presence of a catalyst.

3. An aerogel according to claim 1 or 2, wherein said clay is phyllosilicate mineral species, preferably selected from the group consisting of 2:1 laminar silicates, and more preferably from the subgroup of montmorillonite or sepiolite and mixtures thereof.

4. An aerogel according to any of claims 1 to 3, wherein isocyanate content is from 1 to 60 % by weight of the weight of the initial solvent, preferably from 2 to 40% and more preferably from 5 to 25%.

5. An aerogel according to any of claims 1 to 5, wherein clay content is from 0.5 to 30 % by weight of the weight of the initial solvent, preferably from 0.5 to 20% and more preferably from 0.5 to 10%.

6. An aerogel according to the any of claims 1 to 5, wherein said solvent is selected from the group consisting of a polar aprotic solvent, a non-polar solvent and mixtures thereof.

7. An aerogel according to the any of claims 1 to 6, wherein said catalyst is selected from the group consisting of alkyl amines, aromatic amines, imidazole derivatives, tin derivatives, aza compounds, guanidine derivatives, amidines and mixtures thereof.

8. An aerogel according to the any of claims 1 to 7, wherein catalyst content is from 0.01 to 20 % by weight of the total weight of the initial solvent, preferably from 0.1 to 15% and more preferably from 0.1 to 5%.

9. An aerogel according to the any of claims 1 to 8, wherein said aerogel further comprises at least one reinforcement, wherein said reinforcement is selected from the group consisting of fibres, particles, non-woven and woven fibre fabrics, 3D structures and mixtures thereof.

10. An aerogel according to the any of claims 1 to 9, wherein said aerogel has a solid content from 3 to 30% based on the weight of the initial solvent, preferably from 5 to 20%.

11. An aerogel according to the any of claims 1 to 10, wherein said aerogel has a thermal conductivity less than 80 mW/m·K, preferably less than 60 mW/m·K, more preferably less than 40 mW/m·K, wherein said thermal conductivity is measured by means of the C-Therm TCi.

12. An aerogel according to the any of claims 1 to 11, wherein said aerogel has a compressive Young's modulus more than 0.1 MPa, preferably more than 15 MPa, and more preferably more than 30 MPa, wherein Compression Young Modulus is measured according to the method ASTM D1621.

13. A method for preparing an aerogel according any of claims 1 to 12 comprising the steps of:

1) adding a clay into a solvent and mixing at a stirring rate of greater than 1500 rpm;

2) adding an isocyanate and mixing;

3) adding a catalyst if present, and mixing;

4) letting the mixture to stand in order to form a gel;

5) washing said gel with a solvent; and

6) drying said gel by supercritical drying or ambient drying.

14. A thermal insulating material or an acoustic insulating material comprising an aerogel according any of claims 1 to 12.

15. Use of an aerogel according to the any of claims 1 to 12 as a thermal insulating material or acoustic insulating material.

16. Use of an aerogel according to claim 15 as a thermal insulating material for the storage of cryogens.