

Claims

1. A rubber-based aerogel comprising a porous network of cross-linked rubber fibres, wherein the rubber-based aerogel has a thermal conductivity of 0.030-0.050
5 W/m K.
2. The rubber-based aerogel according to claim 1, wherein the rubber fibres comprised in the rubber-based aerogel are obtained from tyres.
- 10 3. The rubber-based aerogel according to claim 1 or 2, wherein the cross-linked rubber fibres comprised in the rubber-based aerogel are cross-linked with a thermoplastic polymer.
4. The rubber-based aerogel according to claim 1 or 2, wherein the cross-linked
15 rubber fibres comprised in the rubber-based aerogel are cross-linked with a cross-linker selected from: polyvinyl alcohol (PVA), glutaraldehyde (GA), poly(methyl methacrylate) (PMMA), polyamides, polylactic acid (PLA), polyvinyl chloride (PVC), or a combination thereof.
- 20 5. The rubber-based aerogel according to claim 4, wherein the cross-linker is PVA.
6. The rubber-based aerogel according to claim 4, wherein the cross-linker is a combination of PVA and GA.
- 25 7. The rubber-based aerogel according to any preceding claim, wherein the rubber-based aerogel has a density of 0.02-0.20 g/cm³.
8. The rubber-based aerogel according to any preceding claim, wherein the
30 rubber-based aerogel has a compressive Young's modulus of ≤ 5000 kPa.
9. The rubber-based aerogel according to any preceding claim, wherein the rubber-based aerogel is superhydrophobic and has a contact angle of 120-160°.

10. The rubber-based aerogel according to any preceding claim, wherein the rubber-based aerogel has a porosity of $\geq 80\%$.

5 11. A method of forming the rubber-based aerogel according to any preceding claim, the method comprising:

- hydrolysing recycled rubber fibres to form hydrolysed rubber fibres, wherein the hydrolysing forms at least carboxyl groups and hydroxyl groups on a surface of the hydrolysed rubber fibres;
- 10 - cross-linking the hydrolysed rubber fibres with a cross-linker;
- gelation of cross-linked rubber fibres; and
- drying to form the rubber-based aerogel.

12. The method according to claim 11, wherein the cross-linker is a thermoplastic polymer.

13. The method according to claim 11, wherein the cross-linker is: polyvinyl alcohol (PVA), glutaraldehyde (GA), poly(methyl methacrylate) (PMMA), polyamides, polylactic acid (PLA), polyvinyl chloride (PVC), or a combination thereof.

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14. The method according to any of claims 11 to 13, wherein the method further comprises modifying the surface of the rubber-based aerogel.

15. The method according to claim 14, wherein the modifying comprises treating the surface of the rubber-based aerogel with a silane-based compound, amine-based compound, or a combination thereof.

16. The method according to claim 14 or 15, wherein the modifying comprises treating the surface of the rubber-based aerogel with methoxytrimethylsilane (MTMS), methyltriethoxysilane (MTEOS), methyl(triacetoxy)silane, ethyl(triacetoxy)silane, propyl(triacetoxy)silane, methyltris(methylethylketoxime)silane, vinyltris(methylethylketoxime)silane, phenyltris(methylethylketoxime)silane, (3-aminopropyl)triethoxysilane (APTES), tetraethylenepentamine (TEPA), aminomethyl propanol (AMP), polyethylenimine (PEI), or a combination thereof.

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17. The method according to any of claims 11 to 16, wherein the cross-linker is PVA.

18. The method according to claim 17, wherein the cross-linker further comprises
5 GA.

19. The method according to any of claims 11 to 18, wherein the drying comprises:
freeze-drying, ambient pressure drying, or a combination thereof.