

Claims:

1. A method for producing a composite material, comprising the steps of
 - (a) impregnating a 2D-material based aerogel with an impregnation solvent, to form a solvent
5 impregnated aerogel;
 - (b) performing a solvent/water exchange by washing the solvent impregnated aerogel with water,
to replace impregnation solvent with water and form a water impregnated aerogel;
 - (c) performing precursor diffusion by contacting the water impregnated aerogel with an electrolyte
solution containing a deposition precursor, to form a precursor impregnated aerogel;
 - 10 (d) passing a current through a cell comprising the precursor impregnated aerogel as a working
electrode.
2. A method according to claim 1, wherein the 2D-material based aerogel is selected from a graphene
aerogel, graphene oxide aerogel, a reduced graphene oxide aerogel, a carbide aerogel, and a
15 transition metal dichalcogenide aerogel.
3. A method according to claim 1 or 2, wherein the impregnation solvent is selected from methanol,
ethanol, 1-propanol, isopropanol, n-butanol, formic acid, acetone, dimethylformamide and
dimethylsulfoxide.
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4. A method according to any one of the preceding claims, wherein the electrolyte solution is aqueous.
5. A method according to any one of the preceding claims, wherein the deposition precursor is a salt.
- 25 6. A method according to any one of claims 1-4, wherein the deposition precursor is selected from a salt
of platinum, a salt of manganese, a salt of silver, a salt of tungsten, a salt of copper, aniline and
pyrrole.
7. A method according to any one of claims 1-4, wherein the deposition precursor is selected from
30 chloroplatinic acid, manganese acetate, silver nitrate, sodium tungstate dehydrate, lithium
perchlorate/copper sulfate, hydrogen tetrachloroaurate(III), tetraamminepalladium(II) chloride
monohydrate, aniline and pyrrole.
8. A method according to any one of the preceding claims, wherein the current is passed in pulses.
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9. A composite material produced by the method set out in any one of claims 1-8.
10. A composite material, comprising a 2D-material based aerogel and a modifying agent
homogeneously dispersed on the surface of the pores in the aerogel.
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11. A composite material, comprising a 2D-material based aerogel and a modifying agent dispersed on the surface of the pores in the aerogel, wherein the modifying agent is in the form of single atoms or molecules.
- 5 12. A composite material according to claim 10 or claim 11, wherein the 2D-material based aerogel is selected from a graphene aerogel, a graphene oxide aerogel, a reduced graphene oxide aerogel, a carbide aerogel, and a transition metal dichalcogenide aerogel .
- 10 13. A composite material according to any one of claims 10 to 12, wherein the modifying agent is selected from platinum, manganese oxide, silver, tungsten oxide, copper, polyaniline and polypyrrole.