

Claims

1. A carbonized composite comprising:
 - a) a sulfur chain;
 - b) a conductive network;
- 5 wherein said sulfur chain is covalently bonded to said conductive network via one or more C-S bonds; and
 wherein said composite is substantially free of S₈.
2. The carbonized composite of claim 1, wherein said sulfur chain comprises 2-7 sulfur atoms.
- 10 3. The carbonized composite of claims 1-2, wherein said sulfur chain comprises 2-4 sulfur atoms.
4. The carbonized composite of claims 1-3, wherein said conductive network is a carbon-based conductive network.
- 15 5. The carbonized composite of claims 1-4, wherein said conductive network comprises a plurality of C=C and C=N bonds.
6. The carbonized composite of claims 1-5, wherein said composite is provided in the form of clusters of particles, each particle having a diameter of 1 μm or less.
7. The carbonized composite of claims 1-6 wherein sulfur content of the composite is about 20-50 wt.% of the total weight of the composite.
- 20 8. The carbonized composite of claims 1-7, wherein sulfur content of the composite is about 20-40wt% of the total weight of the composite.
9. The carbonized composite of claims 1-8, wherein carbon content of the composite is about 20-50 wt.% of the total weight of the composite.
- 25 10. The carbonized composite of claims 1-9, wherein the composite comprises less than 1 wt.% of hydrogen based on the total weight of the composite.
11. A method of preparing the carbonized composite of claims 1-10, the method comprising the steps of:
 - a) contacting elemental sulfur and a conductive network precursor to form a mixture;
 - b) heating the mixture obtained in step (a) to form a composite; and

- c) heating the composite under inert conditions under a temperature sufficient to remove bulk or unbonded sulfur to thereby obtain said carbonized composite.
12. The method of claim 11, wherein the heating step (b) is performed at a temperature of 300-600°C.
- 5 13. The method of claims 11-12, wherein the heating step (b) is performed at a temperature of about 550°C.
14. The method of claims 11-13, wherein the contacting step (a) comprises grinding particles of elemental sulfur and said polymer to form a homogenous mixture.
- 10 15. The method of claims 11-14, wherein the conductive network precursor and elemental sulfur are contacted at a weight ratio of 1:2 to 1:10.
16. The method of claims 11-15, wherein the conductive network precursor is a polymer.
17. The method of claim 16, wherein the conductive network precursor is a polymer comprising nitrile-functionalized monomer units.
18. The method of claims 16-17, wherein the polymer is polyacrylonitrile,
- 15 19. The method of claims 11-18, wherein the heating step (b) is performed for about 2-10 hours.
20. The method of claims 11-19 wherein the composite is cooled to room temperature after step (b) and before step (c).
- 20 21. The method of any of claims 11-20, wherein the heating step (c) is carried out at a temperature of about 150°C -300°C.
22. An electrochemical cell comprising:
- a) a sodium anode;
 - b) a cathode comprising the carbonized composite of claims 1-10; and
 - c) an electrolyte