Claims

1. A battery comprising an anode, a separator, a cathode comprising a composite material based on sulfur and carbon-based material, and a catholyte, characterized in that the catholyte includes at least one organosulfur species participating in the capacity of the cathode and the composite material has been formed in the melt via a step of melting the sulfur and of blending the sulfur and the carbon-based material .

2. The battery as claimed in claim 1, characterized in that the anode comprises an anode active material comprising sodium or lithium.

3. The battery as claimed in any one of claims 1 to 2, characterized in that the carbon-based material is selected from: carbon black, carbon nanotubes, carbon fibers, graphene, acetylene black, graphite, carbon nanofibers and a mixture thereof in all proportions.

4. The battery as claimed in any one of claims 1 to 3, characterized in that the composite material comprises sulfur in elemental form.

5. The battery as claimed in any one of claims 1 to 4, characterized in that the composite material also includes selenium.

6. The battery as claimed in any one of claims 1 to 5, characterized in that the at least one organosulfur species is selected from: an organic disulfide, an organic polysulfide, a thiol, a polythiol, a thiolate or a polythiolate.

7. The battery as claimed in any one of claims 1 to 6, characterized in that the at least one organosulfur species is selected from the compounds having the following formulae: RS_xR, $R(SH)_n$, $R(SM)_x$, $R(COSH)_n$, $R(COSM)_n$, $RCOS_xR$ and a polymer including one or more functions from among $-S_x-$, $-COS_x-$, -SH, -SM, -COSH and -COSM,

   with:

   M selected from Li and Na;

   R selected from substituted or unsubstituted alkyl or aryl groups,

   x an integer greater than or equal to 2,

   n an integer greater than or equal to 1.

8. The battery as claimed in any one of claims 1 to 7, characterized in that the catholyte also comprises:
    - one or more alkali metal salts, such as ATFSi, AFSi, ANO_3, ATDI, ACF_3SO_3,
    - mineral and organic polysulfide salts of A_zS_x and RS_xA, or
    - mixtures thereof,

    with R selected from substituted or unsubstituted alkyl or aryl groups,
    A selected from Li, Na, K, Rb and Cs,
    x an integer greater than or equal to 2, and
    z an integer greater than or equal to 2.

9. The battery as claimed in any one of claims 1 to 8, characterized in that the catholyte also comprises one or more lithium salts, such as LiTFSi, LiFSi, LiTDI, $LiNO_3$, $LiCF_3SO_3$, and mixtures thereof, and the Li polysulfides: RS_yLi with y an integer greater than or equal to 2 and R selected from substituted or unsubstituted alkyl or aryl groups.

10. The battery as claimed in any one of claims 1 to 9, characterized in that the catholyte may also comprise a polymeric binder.

11. The battery as claimed in any one of claims 1 to 10, characterized in that the at least one organosulfur species is a polymer and is capable of behaving like a polymeric binder.

12. The battery as claimed in claim 11, characterized in that the at least one organosulfur species acting as polymeric binder is selected from a polymer containing the following functions: disulfide -S-S-, polysulfides – S_n- with n an integer greater than or equal to 2, and/or -SH.

13. The battery as claimed in any one of claims 1 to 12, characterized in that the organosulfur species participating in the capacity of the cathode are present in the catholyte in a concentration of greater than or equal to 0.05 mol/L.

14. The battery as claimed in any one of claims 1 to 13, characterized in that it includes mineral sulfur and organic sulfur and in that the mole ratio between the mineral sulfur and the organic sulfur is between 0.05 and 10 and preferably between 0.1 and 7.

15. The battery as claimed in any one of claims 1 to 14, characterized in that the cathode has a theoretical specific capacity of greater than 1700 mAh/g.

16. The battery as claimed in any one of claims 1 to 15, characterized in that the cathode has a specific capacity of greater than 1300 mAh/g measured at a discharging regime equal to C/10.

17. The battery as claimed in any one of claims 1 to 16, characterized in that the cathode has a specific capacity of greater than 500 mAh/g measured at a discharging regime equal to C/1.

18. The battery as claimed in any one of claims 1 to 17, characterized in that the cathode is capable of having a specific capacity of greater than 1000 mAh/g measured at a discharging regime equal to C/1 after 400 cycles.

19. The battery as claimed in any one of claims 1 to 18, characterized in that it does not require a forming step.

20. A process for manufacturing a battery as claimed in one of claims 1 to 18, characterized in that it comprises:
    - a step of preparing a catholyte including at least one organosulfur species participating in the capacity of the cathode and
    - a step of assembling an anode, a cathode, a separator and catholyte.

21. The manufacturing process as claimed in claim 20, characterized in that it does not include a step of forming the battery after the assembly step.