What is claimed is:

1. A battery, comprising:

a) an anode comprising an anode active material comprising sodium, lithium or an alloy or composite of at least one of sodium or lithium with at least one other metal for providing ions;

b) a cathode comprising a cathode active material comprising elemental sulfur, elemental selenium or a mixture of elemental chalcogens; and

c) an intermediate separator element positioned between the anode and cathode acting to separate liquid or gel electrolyte solutions in contact with the anode and cathode, through which metal ions and their counterions move between the anode and cathode during charge and discharge cycles of the battery;

wherein the liquid or gel electrolyte solutions comprise a nonaqueous polar aprotic solvent or polymer and a conductive salt and the anode is comprised of or has been treated with at least one organosulfur species wherein the organosulfur species comprises at least one organic moiety and at least one –S-S_n- linkage, n being 0 or an integer of 1 or more.

2. The battery of claim 1, wherein the organosulfur species is selected from the group consisting of organic polysulfides, organic thiolates and organic polythiolates and mixtures thereof.

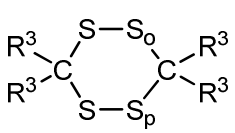
3. The battery of claim 1, wherein the organosulfur species contains one or more sulfur-containing functional groups selected from the group consisting of dithioacetal, dithioketal, trithio-orthocarbonate, thiosulfonate [-S(O)$_2$-S-], thiosulfinate [-S(O)-S-], thiocarboxylate [-C(O)-S-], dithiocarboxylate [-C(S)-S-], thiophosphate, thiophosphonate, monothiocarbonate, dithiocarbonate,and trithiocarbonate.

4. The battery of claim 1, wherein the organosulfur species is selected from the group consisting of aromatic polysulfides, polyether-polysulfides, polysulfide-acid salts and mixtures thereof.

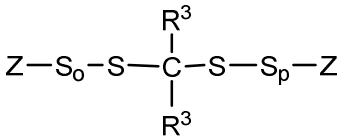
5. The battery of claim 1, wherein the organosulfur species is an organic polysulfide of formula R^1-S-S_n-R^2, wherein R^1 and R^2 independently represent a C_1-C_{20} organic moiety that may be linear, branched, or cyclic aliphatic or aromatic and that may optionally comprise one or more functional groups containing N, O, P, S, Se, Si, Sn, halogen and/or metal, and n is an integer of 1 or more.

6. The battery of claim 1, wherein the organosulfur species is an organic polythiolate of formula R^1-S-S_n-M, wherein R^1 is a C_1-C_{20} organic moiety that may be linear, branched, or cyclic aliphatic or aromatic and that may optionally comprise one or more functional groups containing N, O, P, S, Se, Si, Sn, halogen and/or metal, M is lithium, sodium, potassium, magnesium, quaternary ammonium, or quaternary phosphonium, and n is an integer of 1 or more.

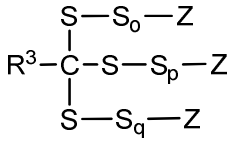
7. The battery of claim 1, wherein the organosulfur species is a dithioacetal or dithioketal of formulas (I) or (II), or a trithio-orthocarboxylate of formula (III):



I



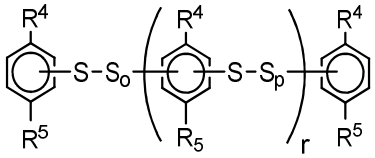
II



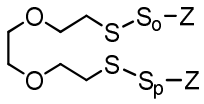
III

wherein each R^3 is independently H or a C_1-C_{20} organic moiety that may be linear, branched, or cyclic aliphatic or aromatic and that may optionally comprise one or more functional groups containing N, O, P, S, Se, Si, Sn, halogen and/or metal, o, p and q are each independently an integer of 1 or more, and each Z is independently: a C_1-C_{20} organic moiety that may be linear, branched, or cyclic aliphatic or aromatic and that may optionally comprise one or more functional groups containing N, O, P, S, Se, Si, Sn, halogen and/or metal; Li; Na; K; Mg; quaternary ammonium; or quaternary phosphonium.

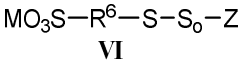
8. The battery of claim 1, wherein the organosulfur species is an aromatic polysulfide of formula (IV), a polyether-polysulfide of formula (V), a polysulfide-acid salt of formula (VI), or a polysulfide-acid salt of formula (VII):



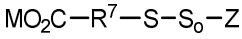
IV



V



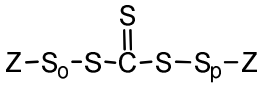
VI



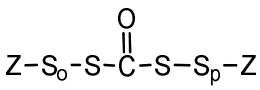
VII

wherein R^4 independently is tert-butyl or tert-amyl, R^5 independently is OH, OLi or ONa, and r is 0 or more in formula (IV) with the aromatic rings being optionally substituted in one or more positions with substituents other than hydrogen, R^6 is a divalent organic moiety in formula (VI), R^5 is a divalent organic moiety in formula (VII), each Z is independently a C_1-C_{20} organic moiety, Li, Na or quaternary ammonium, each M is independently Li, Na, K, Mg, quaternary ammonium, or quaternary phosphonium, and o and p are each independently an integer of 1 or more.

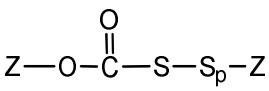
9. The battery of claim 1, wherein the organosulfur species is an organo- or organo-metal polysulfide containing trithiocarbonate functionality of formula (IX), an organo- or organo-metal polysulfide containing dithiocarbonate functionality of formula (X), or an organo- or organo-metal polysulfide containing monothiocarbonate functionality of formula (XI):



IX



X



XI

wherein Z is a C_1-C_{20} organic moiety, Na, Li, quaternary ammonium or quaternary phosphonium, and o and p are each independently an integer of 1 or more.

10. The battery of claim 1, wherein the organosulfur species is pendant to the backbone of the functionalized porous polymer.

11. The battery of claim 1, wherein the organosulfur species is crosslinked into or forms part of the backbone of the functionalized porous polymer.

12. The battery of claim 1, wherein the organic moiety contains at least two carbon atoms.

13. The battery of claim 1, wherein the organic moiety is oligomeric or polymeric and the organosulfur species comprises at least one –S-S- linkage that is pendant to the backbone of the oligomeric or polymeric organic moiety.

14. The battery of claim 1, wherein the organic moiety is oligomeric or polymeric and the organosulfur species comprises at least one –S-S- linkage that in incorporated into the backbone of the oligomeric or polymeric organic moiety.

15. An anode comprising an anode active material comprising sodium, lithium, potassium or magnesium or an alloy or composite of at least one of sodium, lithium, potassium or magnesium with at least one other metal for providing ions, wherein the anode additionally comprises or has been treated with at least one organosulfur species comprising at least one organic moiety and at least one –S-S_n- linkage, n being 0 or an integer of 1 or more.