CLAIMS

1. A system (30) for encapsulating an object (1000) such as an electronic or electrochemical component such as a battery, characterized in that it is formed by three successive layers comprising

(i) a first covering layer (31, 31') composed of an electrically insulating material deposited by atomic layer deposition, which at least partly covers said object, and wherein this first covering layer (31, 31') is conformal,

(ii) a second covering layer (32, 32') comprising parylene and/or polyimide, disposed on the first covering layer,

(iii) a third covering layer (33, 33') deposited on the second covering layer in such a way as to protect the second covering layer, namely, with respect to oxygen, and to increase the service life of the object.

2. A system for encapsulating an object (1000), comprising a covering layer comprising parylene and/or polyimide, and an encapsulation system (30) according to claim 1, deposited on said covering layer comprising parylene and/or polyimide.

3. An electronic or electrochemical component such as a battery, comprising an encapsulation system (30) according to claim 1 or claim 2.

4. An electrochemical component, said component being a battery, said battery comprising

- a stack alternating between at least one anode (10, 10') and at least one cathode (20, 20'), each consisting of a stack of thin films and wherein the anode (10, 10') comprises

-- at least one thin film of an active anode material (12),

and in which stack the cathode (20, 20') comprises at least one thin film of an active cathode material (22), and

- an encapsulation system (30) according to claim 1 or 2, in which said first covering layer (31,31') at least partly covers the stack,

said system partly covering said stack, a first anode (10) or cathode (20) comprising at least one accessible connection zone, while the cathode (20) or the adjacent anode (10) comprises a covering zone (ZRT), which is covered by at least said first covering layer (31,31') and said second covering layer (32,32'), said covering zone being located facing the connection zones (ZC) of the first anode or cathode, in a direction perpendicular to the plane of said stack.

5. The electrochemical component according to claim 4, wherein the anode (10, 10') and/or the cathode (20, 20') comprises a thin film of electrolyte material (13, 23) so that the battery successively comprises at least one thin film of an active anode material (12), at least one thin film of an electrolyte material (13, 23) and at least one thin film of an active cathode material (22).

6. A method for manufacturing an encapsulated electronic or electrochemical component, comprising the formation of an encapsulation system according to claim 1 and wherein the following are successively deposited in such a way as to form said encapsulation system:
- a first covering layer (31,31') composed of an electrically insulating material by atomic layer deposition,
- a second covering layer (32,32') comprising parylene and/or polyimide, deposited on said first covering layer,
- a third covering layer (33,33'), deposited on the second covering layer, able to, and deposited in such a way as to, protect the second encapsulation layer namely from oxygen.

7. A method for manufacturing an encapsulated electronic or electrochemical component, comprising the formation of an encapsulation system according to claim 2 and wherein the following are successively deposited in such a way as to form said encapsulation system:
- a covering layer comprising parylene and/or polyimide on said electronic or electrochemical component,

- a first covering layer (31,31') composed of an electrically insulating material by atomic layer deposition deposited on said covering layer comprising parylene and/or polyimide,
- a second covering layer (32,32') comprising parylene and/or polyimide, deposited on said first covering layer,
- a third covering layer (33,33'), deposited on the second covering layer, able to, and deposited in such a way as to, protect the second encapsulation layer namely from oxygen.

8. The method for manufacturing a thin film battery according to claim 6, said battery comprising a stack alternating between at least one anode (10) and at least one cathode (20, 20'), each consisting of a stack of thin films and wherein the anode (10, 10') comprises:
- at least one thin film of an active anode material (12),
and wherein the cathode (20, 20') comprises
- at least one thin film of an active cathode material (22),
said method comprising the following steps:
(a) a primary superposition is formed, comprising an alternating succession of sheets of cathode and of sheets of anode, said primary superposition being intended to form at least one battery, two adjacent sheets defining at least one protruding region (RS), intended to form said accessible connection zone (ZC), as well as at least one set-back region (RT), intended to form said covering zone (RTC),
(b) the encapsulation system according to claim 1 is deposited by the method according to claim 6.

9. The method for manufacturing a thin film battery according to claim 8, wherein the anode (10, 10') and/or the cathode (20, 20') comprises a thin film of an electrolyte material (13, 23) so that the battery successively comprises at least one thin film of an active anode material (12), at least one thin film of an electrolyte material (13,23) and at least one thin film of an active cathode material (22).

10. The method for manufacturing a battery according to claim 8 or 9, wherein, after step (b), the accessible connection zone (ZC) or each accessible connection zone (ZC) is revealed.

11. The method for manufacturing a battery according to any one of claims 8 to 10, wherein, after step (b), a step (c) is carried out comprising at least one primary cut perpendicularly to the plane of said primary superposition in such a way as to make accessible a connection zone (ZC) at the anode hereinafter anode connection zone and at least one primary cut is carried out perpendicularly to the plane of said primary superposition in such a way as to make accessible a connection zone (ZC) at the cathode hereinafter cathode connection zone.

12. The method for manufacturing a battery according to claim 11, characterized in that the primary cuts are carried out at the opposite edges of said primary superposition.

13. The method for manufacturing a battery according to any one of claims 8 to 10, characterized in that the edges of two adjacent sheets of the primary superposition comprising an alternating succession of sheets of cathode and of sheets of anode are straight edges, the edge of a first sheet forming the protruding region (RS) while the edge of a second sheet forming the set-back region (RR).

14. The method for manufacturing a battery according to any one of claims 8 to 11, characterized in that first notches (50, 50’, 50’’, 50’’’) having a first or big cross-section are made in the edge of a first sheet of the primary superposition comprising an alternating succession of sheets of cathode and of sheets of anode, the wall of said first notches forming said set-back region, and second notches having a second or small cross-section, smaller than the first cross-section, are made in a second adjacent sheet, the wall of said second notches (50, 50’, 50’’, 50’’’) forming said protruding region (RS).

15. The method for manufacturing a battery according to claim 14, characterized in that the sheets of cathode and the sheets of anode, have notches (50, 50’, 50’’, 50’’’) in the shape of a circle.

16. The method for manufacturing a battery according to any one of claims 8 to 11, characterized in that first orifices having a first or big cross-section are made in a first sheet, the wall of said orifices forming said set-back region, second orifices having a second or small cross-section, smaller than the first cross-section, are made in a second adjacent sheet, the wall of said orifices forming said protruding region (RS), the inner volume of said orifices is filled via the encapsulation system and at least one secondary cut is made inside said first and second orifices, so that the connection zones (ZC) are formed near the walls having the small cross-section and the covering zones are formed near the walls having the big cross-section.

17. The method for manufacturing a battery according to any one of claims 8 to 13, characterized in that in two adjacent sheets, first and second slots, mutually offset in the direction perpendicular to the plane of said sheets, are made, the inner volume of said slots is filled via the encapsulation system and at least one secondary cut is made inside said slots, so that the connection zones are formed near the walls of a first slot and the covering zones are formed near the walls of a second slot.

18. The method for manufacturing a battery according to any one of claims 11 to 17, wherein, after step (c), the anode and cathode connection zones (ZC) are electrically connected to each other by thin-film deposition of an electronic conductor and wherein the deposition is carried out by atomic layer deposition (41, 41’).

19. The method for manufacturing a battery according to any one of claims 11 to 17, characterized in that anode and cathode interconnections (40, 40’) are made by metallization of the sections previously covered with a thin film of an electronic conductor.

20. The method for manufacturing a battery according to any one of claims 11 to 17, wherein, after step (c), the anode and cathode connection zones are electrically connected to each other by an interconnection system successively comprising:
- a first electronically conductive layer,
- a second layer (42, 42') containing epoxy resin loaded with silver, deposited on the first electronically conductive layer, and
- a third layer (43, 43') containing tin, deposited on the second layer.

21. The method for manufacturing a battery according to any one of claims 11 to 17, wherein, after step (c), the anode and cathode connection zones are electrically connected to each other by an interconnection system successively comprising:
- a first electronically conductive layer,
- a second layer (42) containing epoxy resin loaded with silver, deposited on the first electronically conductive layer, and
- a third layer (43a) containing nickel, deposited on the second layer,
- a fourth layer (43b) containing tin or copper, deposited on the third layer.

22. The method for manufacturing a battery according to claim 20 or 21, wherein the first electronically conductive layer is optional.

23. The method for manufacturing a battery according to any one of claims 8 to 22, wherein the sheets have dimensions greater than those of the final battery, characterized in that at least one other cut called tertiary is carried out, in a median portion of said sheets.

24. The method for manufacturing a battery according to any one of claims 8 to 23, characterized in that said electrically insulating material is chosen from Al_2O_3, SiO_2, SiO_yN_x, and the epoxy resins.

25. The method for manufacturing a battery according to any one of claims 8 to 24, characterized in that the second covering layer comprises parylene N.

26. The method for manufacturing a battery according to any one of claims 8 to 25, characterized in that the thickness of the first covering thin film is less than 200nm, and the thickness of the second covering layer is between 1μm and 50μm.

27. The method for manufacturing a battery according to any one of claims 8 to 26, characterized in that the thickness of the third covering thin film is between 1μm and 50μm.

28. The method for manufacturing a battery according to any one of claims 8 to 27, characterized in that the layer of anode material is made from a material chosen from:
- the oxynitrides of tin (having the typical formula SnO_xN_y);
- lithiated iron phosphate (having the typical formula $LiFePO_4$);
- the mixed oxynitrides of silicon and tin (having the typical formula $Si_aSn_bO_yN_z$ with $a>0$, $b>0$, $a+b\leq 2$, $0<y\leq 4$, $0<z\leq 3$) (also called SiTON), and in particular $SiSn_{0.87}O_{1.2}N_{1.72}$; as well as the oxynitride-carbides having the typical formula $Si_aSn_bC_cO_yN_z$ with $a>0$, $b>0$, $a+b\leq 2$, $0<c<10$, $0<y<24$, $0<z<17$; $Si_aSn_bC_cO_yN_zX_n$ with X_n at least one of the elements out of F, Cl, Br, I, S, Se, Te, P, As, Sb, Bi, Ge, Pb and $a>0$, $b>0$, $a+b>0$, $a+b\leq 2$, $0<c<10$, $0<y<24$ and $0<z<17$; and $Si_aSn_bO_yN_zX_n$ with X_n at least one of the elements out of F, Cl, Br, I, S, Se, Te, P, As, Sb, Bi, Ge, Pb and $a>0$, $b>0$, $a+b\leq 2$, $0<y\leq 4$ and $0<z\leq 3$;
- the nitrides of the type Si_xN_y (in particular with $x=3$ and $y=4$), Sn_xN_y (in particular with $x=3$ and $y=4$), Zn_xN_y (in particular with $x=3$ and $y=4$), $Li_{3-x}M_xN$ (with M = Co and $0\leq x\leq 0.5$, with M = Ni and $0\leq x\leq 0.6$ or with M = Cu and $0\leq x\leq 0.3$);
- the oxides SnO_2, $Li_4Ti_5O_{12}$, $SnB_{0.6}P_{0.4}O_{2.9}$ and TiO_2.

29. The method according to claim 9, characterized in that the layer of electrolyte material is made from electrolyte material chosen from:

- the garnets;
- the lithiated phosphates;
- the lithiated sulfurated compounds;
- the lithiated borates;
- the oxynitrides;
- the lithiated compounds containing oxynitride of lithium and of phosphorus, called "LiPON", in the form of $Li_xPO_yN_z$ with x ~2.8 and 2y+3z ~7.8 and 0.16 ≤ z ≤ 0.4, the compounds $Li_wPO_xN_yS_z$ with 2x+3y+2z = 5 = w or the compounds $Li_wPO_xN_yS_z$ avec 3.2 ≤ x ≤ 3.8, 0.13≤ y ≤ 0.4, 0 ≤ z ≤ 0.2 , 2.9 ≤ w ≤ 3.3 or the compounds in the form of $Li_tP_xAl_yO_uN_vS_w$ with 5x+3y=5, 2u+3v+2w=5+t, 2.9≤t≤3.3, 0.84≤x≤0.94, 0.094≤y≤0.26, 3.2≤u≤3.8, 0.13≤v≤0.46, 0≤w≤0.2;
- the materials containing oxynitrides of lithium of phosphorus or of boron, respectively called "LiPON" and "LiBON" also capable of containing silicon, sulfur, zirconium, aluminum, or a combination of aluminum, boron, sulfur and/or silicon, and boron for the materials containing oxynitrides of lithium of phosphorus;
- the lithiated compounds containing oxynitride of lithium, of phosphorus and of silicon called "LiSiPON";
- the oxynitrides of lithium of the types LiBON, LiBSO, LiSiPON, LiSON, thio-LiSiCON, LiPONB (or B, P and S respectively represent boron, phosphorus and sulfur);
- the oxynitrides of lithium of the type LiBSO such that $(1-x)LiBO_2 - xLi_2SO_4$ with 0.4 ≤ x ≤ 0.8;
- the lithiated oxides;
- the silicates;
- the solid electrolytes of the antiperovskite type chosen from:
-- Li_3OA with A a halide or a mixture of halides;
-- $Li_{(3-x)}M_{x/2}OA$ with 0 < x ≤ 3, M a divalent metal, A a halide or a mixture of halides;
-- $Li_{(3-x)}M^3_{x/3}OA$ with 0 ≤ x ≤ 3, M^3 a trivalent metal, A a halide or a mixture of halides; or $LiCOX_zY_{(1-z)}$ with X and Y halides as mentioned above in relation to A, and 0 ≤ z ≤ 1;
- the compounds $La_{0.51}Li_{0.34}Ti_{2.94}$, $Li_{3.4}V_{0.4}Ge_{0.6}O_4$, $Li_2O-Nb_2O_5$, $LiAlGaSPO_4$;
- the formulations containing Li_2CO_3, B_2O_3, Li_2O, $Al(PO_3)_3LiF$, P_2S_3, Li_2S, Li_3N, $Li_{14}Zn(GeO_4)_4$, $Li_{3.6}Ge_{0.6}V_{0.4}O_4$, $LiTi_2(PO_4)_3$, $Li_{3.25}Ge_{0.25}P_{0.25}S_4$,

$Li_{1.3}Al_{0.3}Ti_{1.7}(PO_4)_3$, $Li_{1+x}Al_xM_{2-x}(PO_4)_3$ (where M = Ge, Ti, and/or Hf, and where $0 < x < 1$), $Li_{1+x+y}Al_xTi_{2-x}Si_yP_{3-y}O_{12}$ (where $0 \leq x \leq 1$ and $0 \leq y \leq 1$);
- the electrolytes containing polymers that conduct lithium ions impregnated or not with lithium salts; and
- the hybrid electrolytes comprising an inorganic matrix such as a ceramic matrix into which a phase carrying lithium ions is inserted, such as an organic electrolyte comprising at least one lithium salt, a solution formed by a lithium salt dissolved in an organic solvent or a mixture of organic solvents, and/or comprising a polymer containing at least one lithium salt possibly dissolved in an organic solvent or a mixture of organic solvents, and/or comprising at least one ionic liquid containing at least one lithium salt possibly dissolved in an organic solvent or a mixture of organic solvents.

30. Thin film battery capable of being obtained by the method according to any one of claims 8 to 29.

31. Thin film battery capable of being obtained by the method according to any one of claims 11 to 29, characterized in that said encapsulation system totally coats four of the six faces of said battery and partly coats the two laterally opposite remaining faces, said two remaining faces being partly coated by at least said first covering layer (31,31') and at least said second layer (32,32') and said two remaining faces comprising an anode connection zone and a cathode connection zone.