CLAIMS

1. Battery (1000) comprising at least one unit cell (100),

each unit cell (100) successively comprises an anode current-collecting substrate (10), an anode layer (20), at least one layer of an electrolyte material (30) and/or at least one layer of a separator impregnated with an electrolyte (31), a cathode layer (50), and a cathode current-collecting substrate (40),

wherein, in the case where said battery comprises a plurality of unit cells (100, 100', 100''), said unit cells (100, 100', 100'') are disposed one below the other, i.e. superimposed according to a frontal orientation (ZZ) relative to the main plane of the battery, such that, preferably:

- the anode current-collecting substrate (10) is the anode current-collecting substrate (10) of two adjacent unit cells (100, 100', 100''), and such that
- the cathode current-collecting substrate (40) is the cathode current-collecting substrate (40) of two adjacent unit cells (100, 100', 100''),

said at least one unit cell or said unit cells (100, 100', 100'') define a stack (I),

said stack (I) and said battery having six faces, i.e.

- two so-called end faces (F1, F2) opposite one another, in particular parallel to one another, generally parallel to the one or more anode current-collecting substrates (10), to the one or more anode layers (20), to the one or more layers of an electrolyte material (30) or to the one or more layers of a separator impregnated with an electrolyte (31), to the one or more cathode layers (50), and to the one or more cathode current-collecting substrates (40),
- two so-called lateral faces (F3, F5) opposite one another, in particular parallel to one another,
- and two so-called longitudinal faces (F4, F6) opposite one another, in particular parallel to one another,

it being understood that the first longitudinal face (F6) of the battery comprises at least one anode connection zone (1002) and that a second longitudinal face (F4) of the battery comprises at least one cathode connection zone (1006), said anode (1002) and cathode (1006) connection zones being laterally opposite one another,

characterised in that,

- in a first longitudinal direction (XX') of the battery, each anode current-collecting substrate (10) protrudes from each anode layer (20), from each layer of electrolyte material (30) or layer of a separator impregnated with an electrolyte (31), from each

cathode layer (50) and from each cathode current-collecting substrate layer (40), and

- in a second longitudinal direction (XX'') of the battery that is opposite to said first longitudinal direction (XX'), each cathode current-collecting substrate (40) protrudes from each anode layer (20), from each layer of electrolyte material (30) or layer of a separator impregnated with an electrolyte (31), from each cathode layer (50) and from each anode current-collecting substrate layer (10), and
- an encapsulation system covering at least part of the outer periphery of the stack (I), said encapsulation system including at least one impervious cover layer, having a water vapour permeance (WVTR) of less than 10^{-5} g/m^2.d, this encapsulation system being in direct contact at least with said layer of electrolyte material (30) and/or with said layer of a separator impregnated with an electrolyte (31), at each longitudinal face (F4, F6).

2. Battery according to claim 1, characterised in that each anode current-collecting substrate (10) protrudes from a first end plane (DY_a), this first plane being defined by the first longitudinal ends of each anode layer, of each layer of electrolyte material or separator layer, of each cathode layer and of each cathode current-collecting substrate layer.

3. Battery according to claim 1 or 2, characterised in that each cathode current-collecting substrate (40) protrudes from a second end plane (DY'_a), this second plane being defined by the second longitudinal ends of each anode layer, of each layer of electrolyte material or separator layer, of each cathode layer and of each anode current-collecting substrate layer.

4. Battery according to one of claims 1 to 3, characterised in that the encapsulation system is also in direct contact, at each longitudinal face (F4, F6), with the anode layer, the cathode layer and the non-protruding current-collecting substrate.

5. Battery according to one of claims 1 to 4, characterised in that the encapsulation system is electrically insulating, the conductivity of this encapsulation system advantageously being less than 10^{e-11} S.m^{-1}, in particular less than 10^{e-12} S.m^{-1}.

6. Battery according to one of claims 1 to 5, characterised in that said encapsulation system (95) covers the end faces of the stack (F1, F2), the lateral faces (F3, F5) and at least part of the longitudinal faces (F4, F6) such that
   - only each anode edge (1002') of each anode current-collecting substrate (10) protruding from each anode layer (20), from each layer of electrolyte material (30) or separator layer (31), from each cathode layer (50) and from each cathode current-collecting substrate layer (40) in the first longitudinal direction (XX') of the battery, lies flush with a first longitudinal face (F6), and such that
   - only each cathode edge (1006') of each cathode current-collecting substrate (40) protruding from each anode layer (20), from each layer of electrolyte material (30) or separator layer (31), from each cathode layer (50) and from each anode current-collecting substrate layer (20) in the second longitudinal direction (XX") of the battery, lies flush with a second longitudinal face (F4), said second longitudinal face (F4) being preferably opposite and parallel to the first longitudinal face (F6),

   with the understanding that each anode edge (1002') defines an anode connection zone (1002) and each cathode edge (1006') defines a cathode connection zone (1006).

7. Battery according to one of claims 1 to 6, characterised in that the encapsulation system (95) comprises:
   - optionally, a first cover layer, preferably chosen from among parylene, parylene F, polyimide, epoxy resins, silicone, polyamide, sol-gel silica, organic silica and/or a mixture thereof, deposited on at least part of the outer periphery of the stack (I),
   - optionally, a second cover layer consisting of an electrically insulating material, deposited by atomic layer deposition on at least part of the outer periphery of the stack (I), or on the first cover layer,
   - at least a third impervious cover layer, preferably having a water vapour permeance (WVTR) of less than 10^{-5} g/m^2.d, this third cover layer being made of a ceramic material and/or a low melting point glass, preferably a glass with a melting point below 600°C, deposited on at least part of the outer periphery of the stack (I), or on the first cover layer,

   with the understanding that when said second cover layer is present,
   - a succession of said second cover layer and of said third cover layer can be repeated z times, where z ≥ 1, and deposited on the outer periphery of at least the third cover layer, and

- the last layer of the encapsulation system being an impervious cover layer, preferably having a water vapour permeance (WVTR) of less than 10^{-5} g/m^2.d, and being made of a ceramic material and/or a low melting point glass.

8. Battery according to any of the preceding claims, characterised in that at least the anode connection zone (1002), preferably the first longitudinal face (F6) comprising at least the anode connection zone (1002), is covered by an anode contact member (97'), and in that at least the cathode connection zone (1006), preferably the second longitudinal face (F4) comprising at least the cathode connection zone (1006), is covered by a cathode contact member (97''),
with the understanding that said anode (97') and cathode (97'') contact members are capable of producing the electrical contact between the stack (I) and an external conductive element.

9. Battery according to the preceding claim, characterised in that each of the anode (97') and cathode (97'') contact members comprises:
- a first electrical connection layer, disposed on at least the anode connection zone (1002) and at least the cathode connection zone (1006), preferably on the first longitudinal face (F6) comprising at least the anode connection zone (1002) and on the second longitudinal face (F4) comprising at least the cathode connection zone (1006),
this first layer comprising a material filled with electrically conductive particles, preferably a polymeric resin and/or a material obtained by a sol-gel method, filled with electrically conductive particles and more preferably a graphite-filled polymeric resin,
- a second electrical connection layer comprising a metal foil disposed on the first layer of material filled with electrically conductive particles.

10. Battery according to any of the preceding claims, characterised in that the smallest distance (Dca) between the first longitudinal face (F6) comprising at least one anode connection zone (1002) and the first end plane (DY_a) defined by the first longitudinal ends of each anode layer (20), of each layer of electrolyte material (30) and/or separator layer (31), of each cathode layer (50) and of each cathode current-collecting substrate layer (40) is comprised between 0.01 mm and 0.5 mm, and/or in that
the smallest distance (Dcc) between the second longitudinal face (F4) comprising at least one cathode connection zone (1006) and the second end plane (DY'_a) defined by

the second longitudinal ends of each anode layer (20), of each layer of electrolyte material (30) and/or separator layer (31), of each cathode layer (50) and of each anode current-collecting substrate layer (10), is comprised between 0.01 mm and 0.5 mm.

11. Method for manufacturing at least one battery (1000),
each battery comprising at least one unit cell (100),
each unit cell (100) successively comprises an anode current-collecting substrate (10), an anode layer (20), at least one layer of an electrolyte material (30) and/or at least one layer of a separator (31) impregnated with an electrolyte, a cathode layer (50), and a cathode current-collecting substrate (40),
wherein, in the case where said battery (1000) comprises a plurality of unit cells (100, 100', 100''), said unit cells (100, 100', 100'') are disposed one below the other, i.e. superimposed according to a frontal orientation (ZZ) relative to the main plane of the battery, such that, preferably:
  - the anode current-collecting substrate (10) is the anode current-collecting substrate (10) of two adjacent unit cells (100, 100'), and such that
  - the cathode current-collecting substrate (40) is the cathode current-collecting substrate (40) of two adjacent unit cells (100, 100'),

said at least one unit cell (100) or said unit cells (100, 100', 100'') define a stack (I),
said stack (I) and said battery (1000) having six faces, i.e.,
- two so-called end faces (F1, F2) opposite one another, in particular parallel to one another, generally parallel to the one or more anode current-collecting substrates (10), to the one or more anode layers (20), to the one or more layers of an electrolyte material (30) or to the one or more layers of a separator (31) impregnated with an electrolyte, to the one or more cathode layers (50), and to the one or more cathode current-collecting substrates (40),
- two so-called lateral faces (F3, F5) opposite one another, in particular parallel to one another,
- and two so-called longitudinal faces (F4, F6) opposite one another, in particular parallel to one another,

it being understood that the first longitudinal face (F6) of the battery comprises at least one anode connection zone (1002) and that a second longitudinal face (F4) of the battery comprises at least one cathode connection zone (1006), said anode (1002) and cathode (1006) connection zones being laterally opposite one another,
such that

- in a first longitudinal direction (XX') of the battery, each anode current-collecting substrate (10) protrudes from each anode layer (20), from each layer of electrolyte material (30) or layer of a separator (31) impregnated with an electrolyte, from each cathode layer (50) and from each cathode current-collecting substrate layer (40), and
- in a second longitudinal direction (X'') of the battery that is opposite to said first longitudinal direction (XX'), each cathode current-collecting substrate (40) protrudes from each anode layer (20), from each layer of electrolyte material (30) or layer of a separator (31) impregnated with an electrolyte, from each cathode layer (50) and from each anode current-collecting substrate layer (10),

said manufacturing method comprising:

(i) supplying at least one anode current-collecting substrate foil (10) having grooves (80), uncoated zones (82) and zones (81) coated with an anode layer (20), optionally coated with a layer of an electrolyte material (30) or with a separator layer (31), hereinafter referred to as an anode foil (2e),

(ii) supplying at least one cathode current-collecting substrate foil (40) having grooves (70), uncoated zones (72) and zones (71) coated with a cathode layer (50), optionally coated with a layer of an electrolyte material (30) or with a separator layer (31), hereinafter referred to as a cathode foil (5e),

(iii) producing a stack (I) alternating at least one anode foil (2e) having grooves (80), uncoated zones (82) and coated zones (81) with at least one cathode foil (5e) having grooves (70), uncoated zones (72) and coated zones (71), so as to obtain at least one unit cell successively comprising an anode current-collecting substrate (10), an anode layer (20), at least one layer of an electrolyte material (30) or of a separator (31), a cathode layer (50), and a cathode current-collecting substrate (40), and

such that

- in the first longitudinal direction (XX') of the battery, each anode current-collecting substrate (10) protrudes from each anode layer (20), from each layer of electrolyte material (30) and/or separator layer (31), from each cathode layer (50) and from each cathode current-collecting substrate layer (40), and
- in the second longitudinal direction (XX'') of the battery that is opposite to said first longitudinal direction (XX'), each cathode current-collecting substrate (40) protrudes from each anode layer (20), from each layer of electrolyte material (31) and/or separator layer (31), from each cathode layer (50) and from each anode current-collecting substrate layer (10).

(iv) heat treating and/or mechanically compressing the stack (I) of alternating foils obtained in step (iii), so as to form a consolidated stack,

(v) optionally, making a first pair of cuts (DXn, DX'n) allowing a given line (L_n) of batteries (1000) to be separated from at least one other line (L_{n-1}, L_{n+1}) of batteries (1000) formed from said consolidated stack,

(vi) optionally, impregnating the consolidated stack obtained in step (iv) or of impregnating the line (L_n) of batteries (1000) obtained in step (v) when step (v) is carried out, with a phase carrying lithium ions such as liquid electrolytes or an ionic liquid containing lithium salts, such that said separator layer (31) is impregnated by an electrolyte,

(vii) making a second pair of cuts (DYn, DY'n) exposing

- the anode edge (1002') of each anode current-collecting substrate (10) protruding from each anode layer (20), from each layer of electrolyte material (30) or separator layer (31), from each cathode layer (50) and from each cathode current-collecting substrate layer (40) in the first longitudinal direction (XX') of the battery, each anode edge (1002') defining at least one anode connection zone (1002), and
- the cathode edge (1006') of each cathode current-collecting substrate (40) protruding from each anode layer (20), from each layer of electrolyte material (30) or separator layer (31), from each cathode layer (50) and from each anode current-collecting substrate layer (10) in the second longitudinal direction (XX'') of the battery, each cathode edge (1006') defining at least one cathode connection zone (1006),

said second pair of cuts (DYn, DY'n) enabling, when step (v) is carried out, a given battery to be separated from at least one other battery formed from the line (L_n) of batteries (1000).

12. Method according to the preceding claim, characterised in that,
after step (vi) if carried out,
or if step (vi) is not carried out, after step (v) if step (v) is carried out,
or if steps (vi) and (v) are not carried out, after step (iv),
and before step (vii),
a step (viii) of encapsulating the consolidated stack or the line (L_n) of batteries (1000) is carried out, preferably in which at least part of the outer periphery of the stack (I) or of the line (L_n) of batteries (1000), preferably the end faces of the stack (F1, F2) or of the line (L_n) of batteries (FF1, FF2), the lateral faces (F3, F5, FF3, FF5) and at least

part of the longitudinal faces (F4, F6, FF4, FF6), are covered by an encapsulation system (95) such that

- only each anode edge (1002') of each anode current-collecting substrate (10) protruding from each anode layer (20), from each layer of electrolyte material (30) or separator layer (31), from each cathode layer (50) and from each cathode current-collecting substrate layer (40) in the first longitudinal direction (XX') of the battery, lies flush with a first longitudinal face (F6, FF6), and such that
- only each cathode edge (1006') of each cathode current-collecting substrate (40) protruding from each anode layer (20), from each layer of electrolyte material (30) or separator layer (31), from each cathode layer (50) and from each anode current-collecting substrate layer (10) in the second longitudinal direction (XX'') of the battery, lies flush with a second longitudinal face (F4, FF4), said second longitudinal face (F4, FF4) being preferably opposite and parallel to the first longitudinal face (F6, FF6),

with the understanding that each anode edge (1002') defines an anode connection zone (1002) and each cathode edge (1006') defines a cathode connection zone (1006);

said encapsulation system (95) preferably comprising,

- optionally, at least one first cover layer, preferably chosen from among parylene, parylene F, polyimide, epoxy resins, silicone, polyamide, sol-gel silica, organic silica and/or a mixture thereof, deposited on at least part of the outer periphery of the stack (I) or of the line (L_n) of batteries (1000),
- optionally, a second cover layer consisting of an electrically insulating material, deposited by atomic layer deposition,
- on at least part of the outer periphery of the stack (I) or of the line (L_n) of batteries (1000),
- or on the first cover layer, and
- at least one third impervious cover layer, preferably having a water vapour permeance (WVTR) of less than 10^{-5} g/m^2.d, this third cover layer being made of a ceramic material and/or a low melting point glass, preferably a glass with a melting point below 600°C, deposited on at least part of the outer periphery of the stack (I) or of the line (L_n) of batteries (1000), or on the first cover layer,

with the understanding that a sequence of at least one second cover layer and at least one third cover layer can be repeated z times, where $z \geq 1$, and deposited at the outer periphery of at least the third cover layer, and that the last layer of the encapsulation system is an impervious cover layer, preferably having a water vapour permeance

(WVTR) of less than 10^{-5} g/m^2.d, and being made of a ceramic material and/or a low melting point glass.

13. Method according to any of claims 12 or 13, characterised in that after step (vii), at least the anode connection zone (1002), preferably at least the first longitudinal face (F6) comprising at least the anode connection zone (1002), is covered by an anode contact member (97'), capable of producing the electrical contact between the stack (I) and an external conductive element,
and in that at least the cathode connection zone (1006), preferably at least the second longitudinal face (F4) comprising at least the cathode connection zone (1006), is covered by a cathode contact member (97''), capable of producing the electrical contact between the stack (I) and an external conductive element,
said production of anode (97') and cathode (97'') contact members comprising:
    - depositing, on at least the anode connection zone (1002) and on at least the cathode connection zone (1006), preferably on at least the first longitudinal face (F6) comprising at least the anode connection zone (1002) and on at least the second longitudinal face (F4) comprising at least the cathode connection zone (1006), a first electrical connection layer made of a material filled with electrically conductive particles, said first layer preferably being made of polymeric resin and/or a material obtained by a sol-gel method filled with electrically conductive particles,
    - optionally, when said first layer is made of polymeric resin and/or a material obtained by a sol-gel method filled with electrically conductive particles, a drying step followed by a step of polymerising said polymeric resin and/or said material obtained by a sol-gel method, and
    - depositing, on the first layer, a second electrical connection layer comprising a metal foil disposed on the first electrical connection layer,
    - optionally, depositing on the second electrical connection layer a third electrical connection layer comprising a conductive ink.

14. Method according to any of claims 12 to 14, characterised in that the cuts made in step (v) when this step is carried out, and/or in step (vii), are made by laser ablation, preferably in that all of the cuts made in step (v) when this step is carried out, and/or in step (vii) are made by laser.