CLAIMS

1. Hot-pressing tool (O1; O2) intended to be mounted on a press, this tool comprising:
   - a first tool portion (2) equipped with first means (29; 60) for fastening onto a first platen (12),
   - a second tool portion (3) equipped with second means (13, 14; 70) for fastening onto a second platen (10),
   - these two tool portions being mobile with respect to one another between a distant position and a close position, in which they define a pressing chamber (300),
   - means (5) for heating the inner volume of the pressing chamber,
   - the first and second tool portions further being respectively equipped with a first and second pressing member (28, 38), which are suitable for exerting a pressing force on opposite faces of an object to be pressed, received in the pressing chamber,

   characterized in that the heating means are means (5) for heating by optical radiation, and in that the tool further comprises concentration means (26, 28, 36, 38, 46), capable of concentrating the radiation energy in the direction of said object.

2. Tool according to claim 1, characterized in that the heating means comprise at least one member (5) for heating via optical radiation, each heating member comprising:
   - at least one quartz lamp (51),
   - a sleeve (52) for receiving each lamp (51),

- at least one cap (53, 54) axially extending said sleeve, the facing walls of the cap and of the sleeve defining an annular space capable of being placed in communication with a source of heat-transfer fluid.

3. Tool according to the previous claim, characterized in that one of the pressing members defines a polygonal seat (282), in particular rectangular, for receiving said object to be pressed, and a member (5) for heating via optical radiation is provided along each side of this polygonal seat.

4. Tool according to claim 3, characterized in that each heating member (5) is received in an open housing (45), defining an opening (47) for emission of the optical radiation.

5. Tool according to the previous claim, characterized in that the concentration means comprise a reflection section (46), belonging to the walls of the housing (45) for receiving each heating member, said reflection section being placed facing the radiating zone (51) of the heating member, and said reflection section having a coating being capable of sending back the optical-radiation energy.

6. Tool according to the previous claim, characterized in that the walls of the housing (45) further comprise at least one section called absorption section (46’), facing a non-radiating zone (54) of the heating member, in particular its cap, the absorption section having

a coating being suitable for absorbing the radiation energy.

7. Tool according to any one of claims 4 to 6, characterized in that a first tool portion (3) is equipped with an annular supporting member (4), defining the or each housing (45) for receiving a heating member.

8. Tool according to the previous claim, characterized in that the annular supporting member (4) comprises a front face called free front face (42), capable of being stopped against the second tool portion (2).

9. Tool according to the previous claim, characterized in that sealing means are provided between the free front face and the second tool portion, in particular at least one O-ring (42″) received in at least one groove (42′) arranged in said free front face (42).

10. Tool according to any one of claims 7 to 9, characterized in that the annular supporting member (4) is hollowed out with at least one cutout (48), allowing access to a respective reception housing (45), from an outer face (44) of this supporting member.

11. Tool according to claim 10, characterized in that the annual supporting member (4) is provided with at least one shutter (48′) for closing each cutout, removably fastened onto said outer face (44).

12. Tool according to one of claims 7 to 11, characterized in that it comprises transverse-positioning means (2E, 42E), allowing to mutually position the two tool portions in a direction transverse with respect to the pressing direction.

13. Tool according to the previous claim, characterized in that the transverse-positioning means comprise complementary shoulders (2E, 42E), respectively arranged on the supporting member (4) and on the second tool portion (2).

14. Tool according to any one of claims 4 to 13, characterized in that the means for concentrating the radiation energy comprise, for each tool portion, a member (28, 38) for concentrating the optical radiation and a member (26, 36) for reflecting the optical radiation, interposed along the trajectory of the radiation between the emission opening (47) and the seat (282) for receiving the object to be pressed.

15. Tool according to the previous claim, characterized in that the member (28, 38) for concentrating the optical radiation has two opposite front faces, these two opposite front faces being connected by oblique lateral faces (283), each lateral face being adjacent to a respective heating member (5).

16. Tool according to claim 14 or 15, characterized in that the member (28, 38) for concentrating the optical radiation is made from silica.

17. Tool according to claim 15 or 16, characterized in that each member (28, 38) for concentrating the optical radiation forms a pressing member, the upper front face of the lower member for concentrating the optical radiation forming the reception seat (282).

18. Tool according to any one of claims 14 to 17, characterized in that the member (26, 36) for reflecting the optical radiation is disposed against a front face (281) of said member (28, 38) for concentrating the optical radiation.

19. Tool according to claim 18, characterized in that the member (26, 36) for reflecting the optical radiation is made from polished aluminum.

20. Tool according to one of the previous claims, characterized in that it further comprises means (49) for placing the pressing chamber (300) under a controlled atmosphere, capable of being connected to a source for supplying inert gas and/or a source of vacuum.

21. Tool according to one of the previous claims, characterized in that the means for fastening each tool portion onto a respective platen are means for removable fastening of the mechanical type, in particular by screwing (13, 14, 29).

22. Tool according to one of claims 1 to 20, characterized in that the means for fastening each tool portion onto

a respective platen are means for removable fastening of the magnetic type (60, 70).

23. Method for implementing a pressing tool according to any one of claims 3 to 19, wherein:
    - the two tool portions (2, 3) are placed in their mutually distant position,
    - at least one object to be pressed (200) is disposed on the pressing seat (282),
    - the tool portions are moved towards their mutually close position, in such a way as to define the pressing chamber (300) and confine said object in said pressing chamber,
    - the inner volume of this chamber is heated, up to a target temperature,
    - a pressure is exerted on the opposite faces of said object, while maintaining the inner volume of this chamber at a temperature close to the target temperature.

24. Method according to the previous claim, wherein the inner volume of this pressing chamber is placed at a pressure lower than atmospheric pressure sufficient to create a partial vacuum inside the pressing chamber, for example at a pressure less than or equal to 10^{-3}mbar.

25. Method according to claim 23 or 24, wherein a gas, in particular an inert gas, is let into the inner volume of this pressing chamber.

26. Method according to one of claims 23 to 25, wherein at least one of the opposite faces (201, 202) of said object (200) is covered by means of a mechanical protective element (204, 205), further suitable for absorbing the optical-radiation energy, in particular a protective plate having a dark-colored coating.

27. Method according to one of claims 23 to 26, wherein the object is a stack comprising at least one elementary cell, each of which is formed by an anode layer, a cathode layer and an intermediate layer of solid electrolyte.

28. Method according to one of claims 23 to 27, wherein the inner volume of this chamber is brought to a temperature between 400 and 700°C and a pressure between 100 and 200MPa is exerted on the opposite faces of said object.

29. Method according to one of claims 23 to 27, wherein the inner volume of this chamber is brought to a temperature between 100 and 200°C and a pressure between 5 and 10MPa is exerted on the opposite faces of said object.

30. Method according to one of claims 23 to 29, for the implementation of a tool according to claim 21, wherein each tool portion is separately mechanically fastened onto a respective platen.

31. Method according to one of claims 23 to 29, for the implementation of a tool according to claim 22, wherein

the two tool portions are magnetically fastened onto a first platen, the second platen is brought closer in such a way as to magnetically fasten the second tool portion onto this second platen, and the second platen is moved away from the first platen, in such a way as to move the two tool portions away from each other.

32. Method according to one of claims 23 to 31, wherein a plurality of objects to be pressed are disposed, on top of each other, between the pressing members of said pressing tool.

33. Method according to one of claims 23 to 32, wherein a plurality of pressing tools are disposed, on top of each other, between the first and second platen.

34. Facility for manufacturing objects, comprising:
- a pressing tool (O1; O2) according to any one of claims 3 to 19,
- a first and second platen (10, 12),
- means (106) for controlling the pressing tool and the platens,
- manipulation means (112, 114), suitable for placing the objects to be pressed onto the pressing seat of the pressing tool, then for extracting the objects, once pressed, out of said pressing seat.

35. Facility for manufacturing objects according to the previous claim, characterized in that it further comprises a source (110) of vacuum and/or a source (111) of gas, suitable for being connected to end caps

for placing the pressing chamber under a controlled atmosphere.

36. Method for manufacturing an all-solid lithium-ion battery, using a facility according to one of claims 34 or 35, wherein:
    - a stack comprising at least one elementary cell, each of which is formed by an anode layer, a cathode layer and an intermediate layer of solid electrolyte, is placed on the pressing seat, via the manipulation means;
    - said stack is hot pressed by means of said pressing tool;
    - once pressed, said stack is extracted out of said pressing seat, via the manipulation means;
    - said pressed stack is subjected to at least one later finishing operation, in such a way as to obtain said all-solid lithium-ion battery.

37. Method according to the previous claim, wherein the pressing operation is carried out in such a way that at least one layer, preferably all the layers, of said battery have a porosity of less than 20%, preferably less than 10% and even more preferably less than 5%.