CLAIMS

1. Manufacturing process for powder materials by atoms ejection of a target material and subsequently depositing them onto a powder base material, **CHARACTERIZED IN THAT it** comprises the steps of:

a) **selecting** a powder substrate material having a vapor pressure lower than 100 mbar;

b) **optionally performing** a degassing step of the substrate material;

d) **evacuating** the chamber to the lowest possible vacuum pressure, preferably to 5×10^{-6} mbar;

e) **selecting** at least one element of the periodic table having a vapor pressure lower than 100 mbar as a target material;

f) **defining** the type of coating structure to be formed on the surface of the substrate material, which may be a single atom, a cluster, a sub-nanoparticle, or a nanoparticle;

g) **defining** the values of the power density and deposition rate parameters;

h) **introducing** the target materials into the sputtering guns;

i) **initiating** a controlled flow of at least one gas into the vacuum chamber, between 0.1 sccm/cm² and 10 sccm/cm²;

j) **maintaining** the working pressure between 5×10^{-3} mbar and 10^{-1} mbar;

k) **activating** the power supply and stabilizing the plasma at a power density between 0.1 W/cm² and 25 W/cm²;

l) **initiating** the deposition process of atoms of the target material onto the surface of the substrate material;

m) **maintaining** the deposition for a period between 0.3 min/g and 500 min/g to deposit atoms of the target material onto the surface of the substrate material;

n) **maintaining** the atomic concentration below 10 at%;

o) **switching off** the power supply; and

p) **packaging** the coated substrate material.

2. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the selected substrate material is preferably

selected from polymeric, metallic, semiconductor, ceramic, molecular sieve, perovskite, MOF (metal–organic framework), and carbonaceous materials.

3. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the target material preferably has a vapor pressure of 10^{-1} mbar.

4. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the target material is introduced into the equipment in the form of an alloy or as a pure element.

5. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the process for forming cluster-type, sub-nanometric, or nanometric structures comprises at least two target elements fused together.

6. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the process for forming cluster-type, sub-nanometric, or nanometric structures comprises at least two target elements individually introduced into respective guns and deposited onto the substrate material concomitantly.

7. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the process for forming cluster-type, sub-nanometric, or nanometric structures comprises at least two target elements individually introduced into respective guns and deposited onto the substrate material at different times, sequentially.

8. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the degassing step is carried out when the substrate material presents moisture.

9. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the degassing of the substrate material comprises the steps of:

a) **placing** the substrate material in a pre-vacuum chamber;

b) **evacuating** the chamber until a pressure of 2×10^{-2} mbar is reached; and

c) **maintaining** the substrate material in the pre-vacuum chamber for a period between 1 h and 8 h.

10. Manufacturing process for powder materials according to claims 1 and 3, **CHARACTERIZED IN THAT** the degassing period of the substrate material is preferably 3 h.

11. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** defining the coating structure on the surface of the substrate comprises the steps of:

a) **establishing** an initial power density of the equipment between 0.1 and 25 W/cm²;

b) **calibrating** the deposition rate of the target material;

c) **verifying** whether the deposition rate of the target material is suitable to achieve the atomic concentration of the planned structure; and, if not,

d) **adjusting** the power density until the deposition rate is sufficient to achieve the atomic concentration for each structure.

12. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** the gases introduced into the vacuum chamber preferably comprise argon, nitrogen, oxygen, methane, or hydrogen.

13. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT**, alternatively, at the end of the process, a thermal treatment is performed on the coated substrate material.

14. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** gas control is carried out by a mass flow controller system.

15. Manufacturing process for powder materials according to claim 1, **CHARACTERIZED IN THAT** for a single-atom structure the process parameters preferably comprise:

a) a vacuum pressure of 5×10^{-6} mbar;

b) a plasma power density between 0.32 W/cm² and 1.93 W/cm²;

c) a gas flow lower than 1 sccm/cm²;

d) a working pressure of 10^{-3} mbar;

e) a deposition time shorter than 5 min/g; and

f) an atomic concentration lower than 0.1 at%.

16. Manufacturing process for powder materials according to claims 1 and 10, **CHARACTERIZED IN THAT** for a **cluster structure** the process parameters preferably comprise:

a) a vacuum pressure of 5×10^{-6} mbar;

b) a power density between 0.32 W/cm² and 1.93 W/cm²;

c) a gas flow lower than 1 sccm/cm²;

d) a working pressure of 10^{-3} mbar;

e) a deposition time shorter than 10 min/g; and

f) an atomic concentration up to 0.20 at%.

17. Manufacturing process for powder materials according to claims 1 and 10, **CHARACTERIZED IN THAT** for a **sub-nanoparticle structure** the process parameters preferably comprise:

a) a vacuum pressure of 5×10^{-6} mbar;

b) a plasma power density between 0.32 W/cm² and 1.93 W/cm²;

c) a gas flow lower than 2 sccm/cm²;

d) a working pressure of 10^{-3} mbar;

e) a deposition time shorter than 10 min/g; and

f) an atomic concentration between 0.2 at% and 0.25 at%.

18. Manufacturing process for powder materials according to claims 1 and 10, **CHARACTERIZED IN THAT** for a **nanoparticle structure** the process parameters preferably comprise:

a) a vacuum pressure lower than 5×10^{-6} mbar;

b) a power density between 0.32 W/cm² and 1.93 W/cm²;

c) a gas flow lower than 5 sccm/cm²;

d) a working pressure of 10^{-3} mbar;

e) a deposition time shorter than 30 min/g; and

f) an atomic concentration lower than 1 at%.