CLAIMS

1. Method for implanting single or multiply charged ions into a surface of a treated object (30), said method including the step that consists in directing towards the surface of the treated object (30) an ion beam (12) produced by an ion source (1) of the electronic cyclotron resonance (ECR) type, the method also including the steps consisting in:

- producing at least one primary electron beam (28) and directing said primary electron beam (28) so that it passes through the ion beam (12), and
- producing a secondary electron beam (34) by reflection of the primary electron beam (28) onto a target (32) once said primary electron beam has traversed the ion beam (12), the target (32) being oriented such that the secondary electron beam (34) falls onto the surface of the treated object (30).

2. Method according to claim 1, characterized in that the treated object (30) is made of a non-electrically conductive or semiconductor material.

3. Method according to claim 1, characterized in that the material from which the treated object (30) is made is chosen from the group formed by natural and synthetic sapphires, mineral glasses, polymers and ceramics.

4. Method according to claim 2, characterized in that the material from which the treated object (30) is made is chosen from the group formed by natural and synthetic sapphires, mineral glasses, polymers and ceramics.

5. Method according to claim 1, characterized in that the material from which the treated object (30) is made is an electrically conductive material.

6. Method according to claim 2, characterized in that the material from which the treated object (30) is made is an electrically conductive material.

7. Method according to claim 5, characterized in that the material from which the treated object (30) is made is chosen from the group formed by crystalline or amorphous metal alloys, ceramics and precious and non-precious metals.

8. Method according to claim 6, characterized in that the material from which the treated object (30) is made is chosen from the group formed by crystalline or amorphous metal alloys, ceramics and precious and non-precious metals.

9. Method according to any of claims 1 to 8, characterized in that the atoms that are implanted into the surface of the treated object (30) by means of the single or multiply charged ECR ion source (1) are chosen from the group formed by nitrogen N, carbon C, oxygen O, argon Ar, helium He and neon Ne.

10. Method according to claim 9, characterized in that the nitrogen atoms are obtained by ionisation of a dinitrogen precursor gas, the carbon atoms are obtained by ionisation of a methane precursor gas, and the oxygen atoms are obtained by ionisation of a dioxygen precursor gas.

11. Method according to claim 1, characterized in that the surface temperature of the treated object (30) is measured remotely and in real time.

12. Method according to claim 1, characterized in that the electrical potential of the surface of the treated object (30) or the electrical potential of a table (36) that supports the treated object (30) is measured in real time.

13. Method according to claim 12, characterized in that the surface of the treated object (30) is treated by means of at least one ion implantation dose that falls within a range comprised between $1*10^{16}$ ions/cm^2 and $15*10^{16}$ ions/cm^2 and in that the single or multiply charged ion acceleration voltage is comprised between 7.5 kV and 35 kV.

14. Device for implanting single or multiply charged ions into a surface of a treated object (30), said device comprising an ECR ion source (1) and an electron gun (16), the ECR ion source (1) producing an ion beam (12) and the electron gun (16) producing a primary electron beam (28), the

ECR ion source (1) and the electron gun (16) being arranged such that the primary electron beam (28) intercepts the ion beam (12), the single or multiply charged ion implantation device further comprising a target (32) placed on the path of the primary electron beam (28) once the latter has passed through the ion beam (12), the target (32) being oriented such that a secondary electron beam (34), produced by the collision between the electrons of the primary electron beam (28) which have not recombined with the ions of the ion beam (12) and the target (32), impinges on the surface of the treated object (30).

15. Device for implanting single or multiply charged ions according to claim 14, characterized in that the secondary electron beam (34) also impinges on a table (36) on which the treated object is placed (30).

16. Device for implanting single or multiply charged ions according to claim 15, characterized in that the device also includes a temperature sensor (38) for measuring remotely and in real time the surface temperature of the treated object (30).

17. Device for implanting single or multiply charged ions according to claim 15, characterized in that the device includes an instrument (40) for measuring the electrical potential of the surface of the treated object (30) and/or of the table (36) that supports the treated object (30).

18. Device for implanting single or multiply charged ions according to claim 16, characterized in that the device includes an instrument (40) for measuring the electrical potential of the surface of the treated object (30) and/or of the table (36) that supports the treated object (30).