Claims

1. Cathodic arc evaporation apparatus comprising:
   - a target as cathode having
     - o a front-target surface of a material to be evaporated, i.e., the active target surface,
     - o a back-target surface, parallel to the front-target surface but facing a target back plate placed in the opposite side in relation to the front-target surface, and
     - o a side-target surface connecting the front-target surface with the back-target surface,
   - an electrically floating confinement located adjacent, preferably surrounding or at least partially surrounding the side-target surface, the confinement comprising an inner surface and an outer surface, wherein the side-target surface is closer to the inner surface of the confinement than to the outer surface of the confinement.
   - an electrode as anode having an inner surface for acting as electron receiving surface,
   - a magnetic guidance system adapted to provide magnetic fields comprising magnetic field lines located in front of the front-target surface,

   characterized in that:
   - the inner surface of the confinement is placed:
     - between the front-target surface and the electron receiving surface of the anode, if the distance in a perpendicular plane in relation to the front-target surface is considered, and/or

- between the side-target surface and the electron receiving surface of the anode, if the distance in a parallel plane in relation to the front-target surface is considered, and

- the magnetic guidance system designed and adjusted for producing at least following two magnetic fields regions:
  - a first region comprising magnetic field lines located in front of the front-target surface which exit the front-target surface and end in the inner surface of the confinement member, and
  - a second region comprising magnetic field lines located in front of the front-target surface which exit the front-target surface and end in the electron receiving surface of the anode,

2. Apparatus according to claim 1, characterized in that the apparatus comprises a ferromagnetic central limiter electrically floating (16) for modifying the trajectory of the magnetic fields lines that exit the front-target surface in order to make them essentially parallel to the plane of the front-target surface.

3. Method for operating the apparatus according to claim 1 or 2, characterized in that during operation of the apparatus within a vacuum chamber, three plasma zones or plasma regions are produced, wherein:

- a first plasma zone comprises electrons crossing the magnetic fields without having access to the anode,

because of the magnetic field lines that exit the front-target surface and end in the inner surface of the confinement member,

- a second plasma zone, in which electrons are drifted to the anode by the magnetic field lines that exit the front-target surface and end in the electron receiving surface of the anode, and
- a third plasma zone, in which there are not any magnetic field lines which neither exit the front-target surface and end in the inner surface of the confinement member nor exit the front-target surface and end in the electron receiving surface.

4. Method according to claim 3, characterized in that:

- the electron temperature in the first plasma zone is between 1 eV und 5 eV, and
- the electron temperature in the second plasma zone and in the third plasma zone is between 0.3 eV und 1 eV.

5. Method according to claim 3 or 4, characterized in that the method comprises at least one step in which a reactive gas is introduced in the vacuum chamber and the apparatus is operated while the reactive gas is introduced in the vacuum chamber, wherein the first plasma zone comprises more reactive gas ions than the second plasma zone and the third plasma zone, consequently the reactive gas ion density in the first plasma zone being higher than the reactive gas ion density in the second and third plasma zones.

6. Method according to claim 5, characterized in that the target or at least the front-target surface is made of a metallic material and the reactive gas react with the metallic material from the target producing a layer comprising elements from the reactive gas as well as elements from the metallic material.

7. Method according to claim 6, characterized in that the target consists of or comprises Ti or Al or Al and Ti, and the reactive gas is nitrogen or comprises nitrogen, so that the layer resulting from the reaction of reactive gas with metallic material from the target is a nitriding layer consisting of or comprising TiN or AlN or AlTiN, respectively.

8. Method according to claim 7, characterized in that the target material is selected consisting of or comprising Al and Ti in a concentration allowing the synthesis of a coating on a substrate placed in the third plasma zone, which consists of or comprises cubic aluminum nitride having element composition $Al_xTi_{1-x}N$ with x as atomic concentration fraction of Al, wherein X is 0.8.

9. Cathodic arc evaporation apparatus according to claim 1 or 2, comprising

- a target (3) which has a target surface (3') comprising an active surface (3'') from where material can be evaporated in a cathodic arc process;

- a confinement (4) surrounding an outer boarder of the target surface (3’);
- an anode (2) having an electron receiving surface (2’, 2’’, 2’’’), the anode (2) encompassing at least one of the target (3) and the confinement (4) in at least one of a target plane and an axial distance in front of the active surface;
- a magnetic guidance system adapted to provide a magnetic field at the target surface being essentially in parallel to at least an outer region of the target surface so that magnetic field lines are in parallel to the target surface or inclined to it in an acute angle α, whereat an active surface (3’’) is defined in a surface (3’) area where magnetic field lines enter the target surface in an acute angle $\alpha \leq 45°$;
- a central axis Z or a central plane Z’;

wherein the confinement (4) and the anode (2) both are made in closed geometry and both are electrically isolated against each other and the target, whereat the minimum distance of the electron receiving surface (2’, 2’’,2’’’) from the active surface (3’’) is defined by at least one of a radial distance Δr_{14} of an outer boarder of the target surface (3’) to an inner boarder of the electron receiving surface, whereby the outer boarder of the target surface (3’) has a radial distance r1 from the middle of the target and the inner boarder of the electron receiving surface has a radial distance r4 from the middle of the target,

and an axial distance h1 from the target surface (3′) to an upper boarder of the confinement or an axial distance h2 from the target surface (3′) to a lower boarder of the electron receiving surface (2′, 2′′, 2′′′).

~~10. Cathodic arc evaporation apparatus comprising~~

- ~~a target (3) which has a target surface (3′) comprising an active surface (3′′) from where material can be evaporated in a cathodic arc process;~~
- ~~a confinement (4) surrounding an outer boarder of the target surface (3′);~~
- ~~an anode (2) having an electron receiving surface (2′, 2′′, 2′′′), the anode (2) encompassing at least one of the target (3) and the confinement (4) in at least one of a target plane and an axial distance in front of the active surface;~~
- ~~a magnetic guidance system adapted to provide a magnetic field at the target surface being essentially in parallel to at least an outer region of the target surface so that magnetic field lines are in parallel to the target surface or inclined to it in an acute angle α, whereat an active surface (3′′) is defined in a surface (3′) area where magnetic field lines enter the target surface in an acute angle $\alpha \leq 45°$;~~
- ~~a central axis Z or a central plane Z′;~~

- ~~wherein the confinement (4) and the anode (2) both are made in closed geometry and both are electrically isolated against each other and the target, whereat the minimum distance of the electron receiving surface (2', 2'',2''') from the active surface (3'') is defined by at least one of a radial distance Δr_{14} of an outer boarder of the target surface (3') to an inner boarder of the electron receiving surface, whereby the outer boarder of the target surface (3') has a radial distance r1 from the middle of the target and the inner boarder of the electron receiving surface has a radial distance r4 from the middle of the target, and an axial distance h1 from the target surface (3') to an upper boarder of the confinement or an axial distance h2 from the target surface (3') to a lower boarder of the electron receiving surface (2', 2'', 2''').~~

~~11~~10. Apparatus according to one of the previous claims 1 to 2 or 9~~ to 10~~, characterized in that the essentially parallel magnetic field extends from the active target surface (3') at least to an axial distance (h1, h2) of the confinement or the electron receiving surface, and/or extends at least to a height of 5 to 20 mm above the target surface.

~~12~~11. Apparatus according to one of the previous claims 1 to 2 or 9 to ~~11~~10, characterized in that in a zone A above the active target surface, the strength of

the magnetic flux density B_A can be set from 20 to 500 Gauss or even higher.

~~13~~12. Apparatus according to one of the previous claims 1 to 2 or 9 to ~~12~~11, characterized in that the confinement is made of magnetic or non-magnetic material.

~~14~~13. Apparatus according to one of the previous claims 1 to 2 or 9 to ~~13~~12, characterized in that radial distance Δr_{14} is from 5 to 30 mm.

~~15~~14. Apparatus according to one of the previous claims 1 to 2 or 9 to ~~14~~13, characterized in that the radial distance r1 of the outer boarder of the target surface from the center of the apparatus is from 40 to 110 mm.

~~16~~15. Apparatus according to one of the previous claims 1 to 2 or 9 to ~~15~~14, characterized in that the axial distance (h1, h2) is from 0 to 20 mm.

~~17~~16. Apparatus according to one of the previous claims 1 to 2 or 9 to ~~16~~15, characterized in that a maximum axial distance h3 of the electron receiving surface is: $10 \leq h3 \leq 50$.

~~18~~17. Apparatus according to one of the previous claims 1 to 2 or 9 to ~~17~~16, characterized in that the magnetic guidance system comprises at least a central magnet having a pole placed in front of a center of a

back surface of the target and being axially aligned to it, and a peripheral ring magnet having a reciprocal pole in or below a target plane, the ring magnet in prospect encompasses the central magnet and at least a part of the target.

~~19~~18. Apparatus according to claim ~~18~~17, characterized in that at least one of the central magnet and the ring-magnet is an electromagnet or a permanent magnet.

~~20~~19. Apparatus according to one of claims 18 to ~~19~~18, characterized in that the magnetic axis of the ring-magnet is tilt away from the central axis Z or plane Z’ in an upwards direction.

~~21~~20. Apparatus according to one of claims 18 to ~~20~~19, characterized in that the ring-magnet comprises two electromagnetic coils C2 and C3, whereby the diameter of C3 is larger than the diameter of C2.

~~22. Apparatus according to one of claims 18 to 21, characterized in that the magnetic guidance system further comprises a peripheral yoke encompassing the ring-magnet, the target and the anode, the peripheral yoke being made of magnetizable material.~~

~~23. Apparatus according to one of claims 18 to 22, characterized in that the magnetic guidance system further comprises a central limiter arranged in or round~~

~~the center of the target surface, the central limiter being electrically isolated against the target and made of magnetic material having a Curie-temperature T_C > 500°C.~~

~~24. Apparatus according to claim 23, characterized in that the central limiter protrudes 0 to 20 mm above the target surface or to an axial distance h1 or h2.~~

~~25. Apparatus according to claim 23, characterized in that the central limiter is in a plane with the target surface.~~

~~26. Apparatus according to one of claims 23 to 25, characterized in that the confinement is made of non-magnetic material.~~

~~27. Apparatus according to one of the previous claims 1 to 2 or 9 to 26, characterized in that the minimum distance of the electron receiving surface (2', 2'',2''') from the active surface (3') is defined by the radial distance Ar_{14} and the axial distance h1 or h2.~~

~~28. Vacuum chamber comprising a cathodic arc evaporation apparatus according to one of the forgoing claims 1 to 2 or 9 to 27.~~

~~29. Method to deposit a coating on a substrate in a vacuum chamber by use of a cathodic arc evaporation~~

~~apparatus according to one of claims 1 to 2 or 9 to 27, whereat an electron trap is established at least immediately above a target surface within zone A by applying an essentially parallel magnetic field, with magnetic field lines entering the target surface in an acute angle $\alpha \leq 45°$, to at least an outer region of the target surface (3) by use of a magnetic guidance system, whereby an active surface (3'') is formed, and a cathodic arc discharge is ignited and maintained on the active surface, whereat zone A is sidewise delimited by a confinement on floating potential.~~

~~30. Method according to claim 29, characterized in that a zone B is formed above zone A to about an axial distance h3, given by the maximum axial distance of the electron receiving surface from the target surface.~~

~~31. Method according to claim 29 or 30, characterized in that a zone C is formed above zone A and B, wherein the magnetic field is very low or zero and the atmosphere comprises reactive gas molecules and at least one of positively ionized metallic ions, and positively ionized reacted metal ions.~~

~~32. Method according to one of claims 29 to 31, characterized in that the cathodic arc discharge is maintained at a discharge voltage between 20 V to 50 V.~~

~~33. Method according to one of claims 29 to 32, characterized in that the coating is an AlMeN, an AlMeO or an AlMeNO compound, where Me stands for one or more metals of the transition metal group IV, V or VI.~~

~~34. Method to produce a coated substrate by a deposition process according to one of claims 29 to 33.~~

~~35. Method according to claim 24, characterized in that the substrate is a tool or a component.~~