

CLAIMS:

1. Particle detection apparatus comprising electron emissive surface(s) configured to emit secondary electrons in response to impact with a particle, wherein the apparatus is configured so as to maintain spatial separation between (i) secondary electrons emitted as a result of the impact of a first particle in a first region of the electron emissive surface and (ii) secondary electrons emitted as a result of the impact of a second particle in a second region of the electron emissive surface.
2. The particle detection apparatus of claim 1, wherein the first and second regions of the electron emissive surface(s) do not overlap.
3. The particle detection apparatus of claim 1 or claim 2, wherein the first and second regions of the electron emissive surface(s) abut.
4. The particle detection apparatus of claim 3, wherein each of the first and second regions of the electron emissive surfaces(s) has a linear edge, and the linear edges of the first and second regions abut.
5. The particle detection apparatus of any one of claims 1 to 4, wherein each of the first and second regions of the electron emissive surfaces(s) has an axis and the axes are substantially mutually parallel.
6. The particle detection apparatus of any one of claims 1 to 5, wherein the electron emissive surface(s) are fabricated from an electrically resistive material.
7. The particle detection apparatus of any one of claims 1 to 6, comprising electrodes disposed under, over, in, on, or about the electron emissive surface(s), the electrodes positioned such that in use a first electric field is established above the electron emissive surface of the first region, and a second electric field is established above the electron emissive surface of the second region, wherein the first and second electric fields are configured to maintain separation

between (i) secondary electrons emitted as a result of the impact of a first particle in a first region of the electron emissive surface and (ii) secondary electrons emitted as a result of the impact of a second particle in a second region of the electron emissive surface.

8. The particle detection apparatus of claim 7, wherein the electrodes are opposed such that the electric field established by the electrode extends across and above the electron emissive surface(s).

9. The particle detection apparatus of claim 7 or claim 8, wherein the first of the opposed electrodes runs along an edge of the electron emissive surface that is proximal to a target electrode configured to receive a secondary electrode, and the second of the opposed electrodes runs along an edge of the electron emissive surface that is distal to the target electrode

10. The particle detection apparatus of any one of claims 7 to 9, wherein the second of the opposed electrodes comprises elongate regions extending toward the first of the opposed electrodes.

11. The particle detection apparatus of any one of claims 7 to 10, wherein the first and second electric fields are configured so as to transport secondary electrons emitted by the first and second regions of the electron emissive surface(s) toward an edge of the first or second regions of the electron emissive surface(s) respectively.

12. The particle detection apparatus of any one of claims 7 to 11, wherein the first and second electric fields are configured so as to transport secondary electrons emitted by the first and second regions in the same general direction.

13. The particle detection apparatus of any one of claims 7 to 12, wherein the first and second regions of the electron emissive surface(s) have an axis, and the first and second electric fields are configured so as to transport secondary electrons emitted by the first and second regions in a direction generally parallel to the respective axis.

14. The particle detection apparatus of any one of claims 7 to 13, wherein the first and second electric fields are characterized by having lines of electrostatic equipotential that rise above the first and second regions of the electron emissive surface respectively.
15. The particle detection apparatus of claim 14, wherein the lines of electrostatic equipotential that rise above the first region of the electron emissive surface(s) do not intersect with the lines of electrostatic equipotential that rise above the second region of the electron emissive surface(s).
16. The particle detection apparatus of any one of claims 7 to 15, wherein the first and second electric fields are each crossed with a magnetic field.
17. The particle detection apparatus of any one of claims 7 to 16, wherein the first and second electric fields are configured to transport secondary electrons along a non-linear path.
18. The particle detection apparatus of claim 17, wherein the non-linear path is a cycloidal path.
19. The particle detection apparatus of claim 17 or claim 18, wherein the non-linear path of a secondary electron emitted by the electron emissive surface of the first region does not enter the space above the electron emissive surface of the second region.
20. The particle detection apparatus of any one of claims 1 to 19 comprising first and second electron multipliers, the first electron multiplier configured to receive and amplify secondary electrons emitted from the first region of the electron emissive surface(s) and the second electron multiplier configured to receive and amplify secondary electrons emitted from the second region of the electron emissive surface(s).
21. The particle detection apparatus of claim 20, configured such that a secondary electron emitted from the first region of the electron emissive surface(s) is inhibited or prevented from entering the second electron multiplier, and a secondary electron emitted from the second region

of the electron emissive surface(s) is inhibited or prevented from entering the first electron multiplier.

22. The particle detection apparatus of claim 20 or claim 21, wherein the first and/or second electron multipliers is/are a multi-dynode electron multiplier, a continuous electron multiplier (CEM), a multi-channel CEM, a micro channel plate (MCP) electron multiplier; or a cross-field multiplier (including a time-of-flight configuration such as MagneTOFTM). .

23. The particle detection apparatus of claim 22, configured such that a secondary electron that has entered into or been emitted by the first electron multiplier is prevented from entering the second electron multiplier, and a secondary electron that has entered into or been emitted by the second electron multiplier is prevented from entering the first electron multiplier.

24. The particle detection apparatus of any one of claims 1 to 23 configured as a multichannel ion conversion plate capable of emitting second electrons due to impact of an ion therewith, the plate further capable of spatially constraining secondary electrons emitted due to impact of an ion at a first position on the plate and spatially constraining secondary electrons emitted due to impact of an ion at a second position on the plate.

25. The particle detection apparatus of any one of claims 20 to 24 comprising a first target electrode and a second target electrode, wherein the first electron target electrode is configured to receive electrons transported from the first region of the electron emissive surface(s), and the second target electrode is configured to receive electrons from the second region of the electron emissive surface(s).

26. The particle detection apparatus of claim 25, wherein the first target electrode and second target electrode are each a dynode of an electron multiplier (including a discrete dynode electron multiplier, a continuous electron multiplier (CEM), a multi-channel CEM; a cross-field electron multiplier (including a time-of-flight configuration such as MagneTOFTM), and a micro channel plate (MCP),, or an electron collector.

27. The particle detection apparatus of claim 25 or claim 26, comprising processing means configured to receive a signal as input from the electron multiplier or the electron collector, wherein the processing means is configured to mathematically transform the signals such that the apparatus functions so as to have a dynamic range or mass resolution that is greater than the dynamic range of a similar apparatus having a single region of the electron emissive surface(s).

28. A mass spectrometer comprising the particle detection apparatus of any one of claims 1 to 27.

29. A method for the detection of particles, the method comprising:

providing electron emissive surfaces(s),
establishing an electric field(s) above the electron emissive surface(s), the electric field(s) configured to spatially constrain secondary electrons emitted due to impact of a particle at a first position on the electron emissive surface and spatially constraining secondary electrons emitted due to impact of a particle at a second position on the electron emissive surface,
causing or allowing a particle to impact at a first position on the electron emissive surface,
causing or allowing a particle to impact at a second position on the electron emissive surface, and
separately collecting secondary electrons emitted resulting from the particle impacting at the first position on the electron emissive surface and secondary electrons resulting from the particle impacting at the second position on the electron emissive surface.

31. The method of claim 30, wherein first and second electric fields are established, the first electric field configured so as to spatially constrain secondary electrons emitted due to impact of a particle at a first position on the electron emissive surface, and the second electrical field configured so as to spatially constrain secondary electrons emitted due to impact of a particle at a second position on the electron emissive surface.

32. The method of claim 31, wherein the first and second electric fields are configured so as to transport secondary electrons emitted by the first and second regions of the electron emissive surface(s) toward an edge of the first or second regions of the electron emissive surface(s) respectively.
33. The method of claim 31 or 32, wherein the first and second electric fields are configured so as to transport secondary electrons emitted by the first and second regions in the same general direction.
34. The method of any one of claims 31 to 33, wherein the first and second regions of the electron emissive surface(s) have an axis, and the first and second electric fields are configured so as to transport secondary electrons emitted by the first and second regions in a direction generally parallel to the respective axis.
35. The method of any one of claims 31 to 34, wherein the first and second electric fields are characterized by having lines of electrostatic equipotential that rise above the first and second regions of the electron emissive surface respectively.
36. The method of claim 35, wherein the lines of electrostatic equipotential that rise above the first region of the electron emissive surface(s) do not intersect with the lines of electrostatic equipotential that rise above the second region of the electron emissive surface(s).
37. The method of any one of claims 31 to 36, wherein the first and second electric fields are each a crossed electric and magnetic field.
38. The method of any one of claims 7 to 16, wherein the first and second electric fields are configured to transport secondary electrons along a non-linear path.
39. The method of claim 38, wherein the non-linear path is a cycloidal path.

40. The method of claim 38 or claim 39, wherein the non-linear path of a secondary electron emitted by the electron emissive surface of the first region does not enter the space above the electron emissive surface of the second region.

41. The method of any one of claims 29 to 40, wherein the electron emissive surface(s) are provided by the particle detection apparatus of any one of claims 1 to 28.