WHAT IS CLAIMED IS:

1. A multi-beam apparatus for observing a surface of a sample, comprising:

an electron source;

a condenser lens below said electron source;

a source-conversion unit below said condenser lens;

an objective lens below said source-conversion unit;

a deflection scanning unit below said source-conversion unit;

a sample stage below said objective lens;

a beam separator below said source-conversion unit;

a secondary projection imaging system; and

an electron detection device with a plurality of detection elements,

wherein said electron source, said condenser lens and said objective lens are aligned with a primary optical axis of said apparatus, and said sample stage sustains said sample so that said surface faces to said objective lens,

wherein said source-conversion unit comprises a beamlet-forming means with a plurality of beam-limit openings and an image-forming means with a plurality of electron optics elements,

wherein said electron source generates a primary-electron beam along said primary optical axis, and said primary-electron beam is focused by said condenser lens to become a substantially parallel beam and then incident into said source-conversion unit,

wherein a plurality of beamlets of said primary-electron beam exits from said source-conversion unit, said plurality of beamlets respectively passes through said plurality of beam-limit openings and is deflected by said plurality of electron optics elements towards said primary optical axis, and deflection angles of said plurality of beamlets are different;

wherein said plurality of beamlets is focused by said objective lens onto said surface and forms a plurality of probe spots thereon, said deflection scanning unit deflects said plurality of beamlets to scan said plurality of probe spots respectively over a plurality of scanned regions within an observed area on said surface, and currents of said plurality of probe spots are limited by said plurality of beam-limit openings,

wherein a plurality of secondary electron beams is generated by said plurality of probe spots respectively from said plurality of scanned regions and

directed into said secondary projection imaging system by said beam separator, said secondary projection imaging system focuses and keeps said plurality of secondary electron beams to be detected by said plurality of detection elements respectively, and each detection element therefore provides an image signal of one corresponding scanned region.

2. The apparatus according to claim 1, wherein said deflection angles are individually set to reduce aberrations of said plurality of probe spots respectively.

3. The apparatus according to claim 2, wherein said plurality of electron optics elements is below and aligned with said plurality of beam-limit openings respectively.

4. The apparatus according to claim 3, wherein each of said plurality of electron optics elements is a 4-pole lens.

5. The apparatus according to claim 3, wherein currents of said plurality of probe spots are varied by using said condenser lens to change a current density of said primary-electron beam incident into said source-conversion unit.

6. The apparatus according to claim 5, further comprising a pre-beamlet-forming means with a plurality of beamlet-forming apertures above said source-conversion unit, wherein said plurality of beamlets passes through said plurality of beamlet-forming apertures respectively and most of electrons outside said plurality of beamlets are cut off.

7. The apparatus according to claim 3, wherein said plurality of electron optics elements compensates one or up to all of field curvature, astigmatism and distortion aberrations of said plurality of probe spots to further reduce sizes and distortions thereof.

8. The apparatus according to claim 7, wherein each of said plurality of electron optics elements is an 8-pole lens.

9. The apparatus according to claim 7, wherein each of said plurality of electron optics elements comprises one micro-lens and two 4-pole lenses which are aligned with and placed along an optical axis of said each element, and said two 4-pole lenses have a 45° difference in azimuth.

10. The apparatus according to claim 9, wherein for said each of said plurality of electron optics elements, one of said two 4-pole lenses is on a beamlet exit side and one corresponding beamlet is deflected by said one 4-pole lens.

11. The apparatus according to claim 7, wherein currents of said plurality of probe spots are varied by using said condenser lens to change a current density of said primary-electron beam incident into said source-conversion unit.

12. The apparatus according to claim 11, wherein said condenser lens comprises multiple annular electrodes which are placed at different axial positions along and aligned with said primary optical axis, and voltages thereof can be adjusted to change said current density.

13. The apparatus according to claim 11, wherein said condenser lens comprises at least two single magnetic lenses which are placed at different axial positions along and aligned with said primary optical axis, and excitations thereof can be adjusted to change said current density.

14. The apparatus according to claim 11, wherein said condenser lens comprises multiple annular electrodes and at least one single magnetic lens which are placed at different axial positions along and aligned with said primary optical axis, and voltages of said electrodes and excitations of said at least one single magnetic lens can be adjusted to change said current density.

15. The apparatus according to claim 11, further comprising a pre-beamlet-forming means with a plurality of beamlet-forming apertures above said source-conversion unit, wherein said plurality of beamlets passes through said plurality of beamlet-forming apertures respectively and most of electrons

outside said plurality of beamlets are cut off.

16. The apparatus according to claim 10, wherein said condenser lens comprises at least two single magnetic lenses which are placed at different axial positions along and aligned with said primary optical axis, and excitations thereof can be adjusted to change a current density of said primary-electron beam incident into said source-conversion unit.

17. The apparatus according to claim 16, wherein landing energies of said plurality of beamlets on said surface are varied by changing a potential thereof.

18. The apparatus according to claim 17, further comprising a pre-beamlet-forming means with a plurality of beamlet-forming apertures above said source-conversion unit, wherein said plurality of beamlets passes through said plurality of beamlet-forming apertures respectively and most of electrons outside said plurality of beamlets are cut off.

19. A multi-beam apparatus for observing a surface of a sample, comprising:

an electron source;

a condenser lens below said electron source;

a source-conversion unit below said condenser lens;

an objective lens below said source-conversion unit;

a deflection scanning unit below said source-conversion unit;

a sample stage below said objective lens;

a beam separator below said source-conversion unit;

a secondary projection imaging system; and

an electron detection device with a plurality of detection elements,

wherein said electron source, said condenser lens and said objective lens are aligned with a primary optical axis of said apparatus, and said sample stage sustains said sample so that said surface faces to said objective lens,

wherein said source-conversion unit comprises a beamlet-forming means with a plurality of beam-limit openings and an image-forming means with a plurality of electron optics elements,

wherein said electron source generates a primary-electron beam along

said primary optical axis, said condenser lens focuses said primary-electron beam and said primary-electron beam then is incident into said source-conversion unit with a convergent or divergent angle,

wherein a plurality of beamlets of said primary-electron beam exits from said source-conversion unit, said plurality of beamlets respectively passes through said plurality of beam-limit openings and is deflected by said plurality of electron optics elements towards said primary optical axis,

wherein said plurality of beamlets is focused by said objective lens onto said surface and forms a plurality of probe spots thereon, deflection angles of said plurality of beamlets are individually set to reduce aberrations of said plurality of probe spots respectively, said deflection scanning unit deflects said plurality of beamlets to scan said plurality of probe spots respectively over a plurality of scanned regions within an observed area on said surface, and currents of said plurality of probe spots are limited by said plurality of beam-limit openings,

wherein a plurality of secondary electron beams is generated by said plurality of probe spots respectively from said plurality of scanned regions and directed into said secondary projection imaging system by said beam separator, said secondary projection imaging system focuses and keeps said plurality of secondary electron beams to be detected by said plurality of detection elements respectively, and each detection element therefore provides an image signal of one corresponding scanned region.

20. The apparatus according to claim 19, wherein said plurality of electron optics elements compensates one or up to all of field curvature, astigmatism and distortion aberrations of said plurality of probe spots to further reduce sizes and distortions thereof.

21. The apparatus according to claim 19, wherein currents of said plurality of probe spots are varied by using said condenser lens to adjust a current density of said primary-electron beam incident into said source-conversion unit.

22. The apparatus according to claim 21, wherein said plurality of electron optics elements compensates one or up to all of field curvature, astigmatism and

distortion aberrations of said plurality of probe spots to further reduce sizes and distortions thereof.

23. The apparatus according to claim 22, wherein said plurality of electron optics elements is below said plurality of beam-limit openings.

24. The apparatus according to claim 23, further comprising a pre-beamlet-bending means with a plurality of pre-bending micro-deflectors respectively above said plurality of beam-limit openings.

25. The apparatus according to claim 24, wherein said plurality of pre-bending micro-deflectors deflects said plurality of beamlets to be perpendicularly incident into said plurality of beam-limit openings.

26. The apparatus according to claim 25, further comprising a pre-beamlet-forming means with a plurality of beamlet-forming apertures above said source-conversion unit, wherein said plurality of beamlets passes through said plurality of beamlet-forming apertures respectively and most of electrons outside said plurality of beamlets are cut off.

27. A multi-beam apparatus for observing a surface of a sample, comprising:

an electron source;

a beamlet-forming plate providing a plurality of beam-limit openings below said electron source;

a condenser lens below said beamlet-forming plate;

a plurality of electron optics elements below said condenser lens;

an objective lens below said plurality of electron optics elements;

a deflection scanning unit below said plurality of electron optics elements;

a sample stage below said objective lens;

a beam separator below said plurality of electron optics elements;

a secondary projection imaging system; and

an electron detection device with a plurality of detection elements,

wherein said electron source, said condenser lens and said objective lens are aligned with a primary optical axis of said apparatus, and said sample

stage sustains said sample so that said surface faces to said objective lens,

wherein said electron source generates a primary-electron beam along said primary optical axis, said beamlet-forming plate trims said primary-electron beam into a plurality of beamlets respectively passing through a plurality of through-holes of a first group therein, and said plurality of through-holes functions as a plurality of beam-limit openings of said apparatus,

wherein said condenser lens focuses said plurality of beamlets to be deflected by said plurality of electron optics elements respectively towards said primary optical axis,

wherein said plurality of beamlets is focused by said objective lens onto said surface and forms a plurality of probe spots thereon, deflection angles of said plurality of beamlets are individually set to reduce aberrations of said plurality of probe spots respectively, said deflection scanning unit deflects said plurality of beamlets to scan said plurality of probe spots respectively over a plurality of scanned regions within an observed area on said surface, and currents of said plurality of probe spots are limited by said plurality of beam-limit openings,

wherein a plurality of secondary electron beams is generated by said plurality of probe spots respectively from said plurality of scanned regions and directed into said secondary projection imaging system by said beam separator, said secondary projection imaging system focuses and keeps said plurality of secondary electron beams to be detected by said plurality of detection elements respectively, and each detection element therefore provides an image signal of one corresponding scanned region.

28. The apparatus according to claim 27, wherein said plurality of beamlets is perpendicularly incident into said plurality of electron optics elements.

29. The apparatus according to claim 28, wherein said plurality of electron optics elements compensates one or up to all of field curvature, astigmatism and distortion aberrations of said plurality of probe spots to further reduce sizes and distortions thereof.

30. The apparatus according to claim 29, wherein currents of said plurality of beamlets are varied by adjusting an angular intensity of said electron source.

31. The apparatus according to claim 29, wherein currents of said plurality of beamlets are varied by changing radial sizes of said plurality of beam-limit openings.

32. The apparatus according to claim 31, wherein said radial sizes are changed by moving said beamlet-forming plate to locate a plurality of through-holes of a second group therein as said plurality of beam-limit openings.

33. A method to form a plurality of probe spots in a SEM, comprising steps of:

generating a primary-electron beam by an electron source;

collimating or substantially collimating said primary-electron beam by a condenser lens;

trimming said collimated primary-electron beam into a plurality of beamlets by a first plate with first through-holes;

deflecting said plurality of beamlets towards an optical axis of an objective lens with different deflection angles by a plurality of electron optics elements; and

focusing said plurality of deflected beamlets onto a being-observed surface of a sample by said objective lens, wherein said plurality of deflected and focused beamlets forms said plurality of probe spots.

34. The method according to claim 33, further comprising a step of individually setting said deflection angles to reduce aberrations of said plurality of probe spots respectively.

35. The method according to claim 34, further comprising a step of compensating one or up to all of field curvature, astigmatism and distortion aberrations of said plurality of probe spots by said plurality of electron optics elements.

36. The method according to 35, further comprising a step of varying a current density of said collimated primary-electron beam by moving a first principal plane of said condenser lens.

37. The method according to 36, further comprising a step of cutting off most of electrons outside said plurality of beamlets by a second plate with second through-holes before said trimming step.

38. A method to form a plurality of probe spots in a SEM, comprising steps of:

generating a primary-electron beam by an electron source;

trimming said primary-electron beam into a plurality of beamlets by a plate with a plurality of through-holes;

focusing said plurality of beamlets by a condenser lens;

deflecting said plurality of beamlets towards an optical axis of an objective lens by a plurality of electron optics elements;

focusing said plurality of deflected beamlets onto a being-observed surface of a sample by said objective lens, wherein said plurality of deflected and focused beamlets forms said plurality of probe spots; and

setting deflection angles of said plurality of deflected beamlets individually to reduce aberrations of said plurality of probe spots respectively.

39. The method according to claim 38, further comprising a step of compensating one or up to all of field curvature, astigmatism and distortion aberrations of said plurality of probe spots by said plurality of electron optics elements.

40. The method according to claim 39, further comprising a step of varying currents of said plurality of beamlets by changing an angular intensity of said electron source.

41. The method according to claim 39, further comprising a step of changing currents of said plurality of beamlets by using another plurality of through-holes of said plate in said trimming step.

42. A device for providing multiple sources, comprising:

a charged-particle source for providing a primary beam along an optical axis of the device;

means for substantially collimating the primary beam;

means for imaging a plurality of virtual images of the charged-particle source with a plurality of beamlets of the collimated primary beam, wherein the plurality of virtual images becomes the multiple sources which emit the plurality of beamlets respectively, wherein deflection angles of said plurality of beamlets are different or individually set;

means for varying currents of the plurality of beamlets, wherein varying the currents involves changing either or both a focusing power and position of a plane of a condenser lens; and

a beamlet-forming means closely arranged to an electron source.

43. The device according to claim 43, further comprising means for suppressing Coulomb effect due to the primary beam.

44. A multi-beam apparatus, comprising:

the device for providing the multiple sources according to claim 44;

means for projecting the plurality of virtual images on a sample surface such that a plurality of probe spots is formed thereon;

means for scanning the plurality of probe spots on the sample surface; and

means for receiving a plurality of signal particle beams generated from the sample surface due to plurality of probe spots.

45. The multi-beam apparatus according to claim 44, further comprising means for individually deflecting the plurality of beamlets to reduce aberrations of the plurality of probe spots respectively.

46. The multi-beam apparatus according to claim 45, further comprising means for individually compensating the aberrations of the plurality of probe spots.

47. The multi-beam apparatus according to claim 46, wherein the projecting means is a single objective lens.