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-limit means with a plurality of beam-limit openings, and an image-forming means with a plurality of electron optics elements and movable along said primary optical axis,

wherein said electron source generates a primary-electron beam along said primary optical axis and said condenser lens focuses said primary-electron beam,

wherein a plurality of beamlets of said primary-electron beam pass through said plurality of beam-limit openings respectively, and is deflected by said plurality of electron optics elements towards said primary optical axis to form a plurality of virtual images of said electron source respectively,

wherein said plurality of beamlets is focused by said objective lens onto said surface and therefore forms a plurality of probe spots thereon respectively, and 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,

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; and

wherein pitches of said plurality of probe spots are varied together by moving said image-forming means along said primary optical axis.

2. The apparatus according to claim 1, wherein deflection angles of said plurality of beamlets due to said plurality of electron optics elements are respectively set to reduce off-axis aberrations of said plurality of probe spots.

3. The apparatus according to claim 2, wherein said objective lens comprises a magnetic lens and an electrostatic lens.

4. The apparatus according to claim 3, wherein an orientation of said plurality of probe spots is selectable by varying a ratio of focusing powers of said magnetic lens and said electrostatic lens.

5. The apparatus according to claim 2, wherein said deflection angles ensure said plurality of beamlets to land on said surface perpendicularly or substantially perpendicularly.

6. The apparatus according to claim 2, wherein said deflection angles ensure said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

7. The apparatus according to claim 5, wherein said deflection scanning unit is above a front focal plane of said objective lens.

8. The apparatus according to claim 7, wherein said deflection scanning unit tilts said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

9. The apparatus according to claim 5, further comprising a beamlet-tilting deflector between said source-conversion unit and a front focal plane of said objective lens.

10. The apparatus according to claim 9, wherein said beamlet-tilting deflector tilts said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

11. 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-limit means with a plurality of beam-limit openings, a first image-forming means with a plurality of first electron optics elements and a second image-forming means with a plurality of second electron optics elements, said second image-forming means is below said first image-forming means and movable in a radial direction, and one of said first image-forming means and said second image-forming means is used as an active image-forming means,

wherein said electron source generates a primary-electron beam along said primary optical axis and said condenser lens focuses said primary-electron beam,

wherein a plurality of beamlets of said primary-electron beam pass through said plurality of beam-limit openings respectively, and is deflected by said active image-forming means towards said primary optical axis to form a plurality of virtual images of said electron source respectively,

wherein said plurality of beamlets is focused by said objective lens onto said surface and therefore forms a plurality of probe spots thereon respectively, and said deflection scanning unit deflect 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,

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;

wherein deflection angles of said plurality of beamlets due to said active image-forming means are respectively set to reduce off-axis aberrations of said plurality of probe spots; and

wherein pitches of said plurality of probe spots are varied together by changing said active image-forming means between said first image-forming means and said second image-forming means, and when said first image-forming means is selected, said second image-forming means is moved outside so as not to block said plurality of beamlets.

12. The apparatus according to claim 11, wherein said objective lens comprises a magnetic lens and an electrostatic lens.

13. The apparatus according to claim 12, wherein an orientation of said plurality of probe spots is selectable by varying a ratio of focusing powers of said magnetic lens and said electrostatic lens.

14. The apparatus according to claim 11, wherein said deflection angles ensure said plurality of beamlets to land on said surface perpendicularly or substantially perpendicularly.

15. The apparatus according to claim 11, wherein said deflection angles ensure said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

16. The apparatus according to claim 14, wherein said deflection scanning unit is above a front focal plane of said objective lens.

17. The apparatus according to claim 16, wherein said deflection scanning unit tilts said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

18. The apparatus according to claim 14, further comprising a beamlet-tilting deflector between said source-conversion unit and a front focal plane of said objective lens.

19. The apparatus according to claim 18, wherein said beamlet-tilting deflector tilts said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

20. 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, a first principal plane of said objective lens is movable along said primary optical axis, and said sample stage sustains said sample so that said surface faces to said objective lens,

wherein said source-conversion unit comprises a beamlet-limit 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 condenser lens focuses said primary-electron beam,

wherein a plurality of beamlets of said primary-electron beam pass through said plurality of beam-limit openings respectively, and is deflected by said plurality of electron optics elements towards said primary optical axis to form a plurality of virtual images of said electron source respectively,

wherein said plurality of beamlets is focused by said objective lens onto said surface and therefore forms a plurality of probe spots thereon respectively, and 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,

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, and wherein pitches of said plurality of probe spots are varied together by moving said first principal plane along said primary optical axis.

21. The apparatus according to claim 20, wherein deflection angles of said plurality of beamlets due to said plurality of electron optics elements are respectively set to reduce off-axis aberrations of said plurality of probe spots.

22. The apparatus according to claim 21, wherein said deflection angles ensure said plurality of beamlets to land on said surface perpendicularly or substantially perpendicularly.

23. The apparatus according to claim 21, wherein said deflection angles ensure said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

24. The apparatus according to claim 22, wherein said deflection scanning unit is above a front focal plane of said objective lens.

25. The apparatus according to claim 24, wherein said deflection scanning unit tilts said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

26. The apparatus according to claim 22, further comprising a beamlet-tilting deflector between said source-conversion unit and a front focal plane of said objective lens.

27. The apparatus according to claim 26, wherein said beamlet-tilting deflector tilts said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

28. The apparatus according to claim 21, wherein said objective lens comprises a lower magnetic lens and an electrostatic lens.

29. The apparatus according to claim 28, wherein said electrostatic lens comprises a field-control electrode and a field-moving electrode, and generates an electrostatic field.

30. The apparatus according to claim 29, wherein a potential of said field-control electrode is set to control said electrostatic field on said surface for said sample free of electrical breakdown.

31. The apparatus according to claim 30, wherein a potential of said field-moving electrode is set to move said electrostatic field for moving said first principal plane.

32. The apparatus according to claim 30, wherein an orientation of said plurality of probe spots is selectable by varying either or both of potentials of said field-control electrode and said field-moving electrode.

33. The apparatus according to claim 28, further comprising an upper magnetic lens above said lower magnetic lens.

34. The apparatus according to claim 33, wherein said first principal plane is moved by varying a ratio of focusing powers of said lower magnetic lens and said upper magnetic lens.

35. The apparatus according to claim 33, wherein an orientation of said plurality of probe spots is selectable by setting polarities of magnetic fields of said upper and lower magnetic lenses same or opposite.

36. 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;

a transfer lens below said source-conversion unit;

a field lens below said transfer lens;

an objective lens below said field lens;

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, said transfer lens, said field 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-limit 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 condenser lens focuses said primary-electron beam,

wherein a plurality of beamlets of said primary-electron beam pass through said plurality of beam-limit openings respectively, and is deflected by said plurality of electron optics elements towards said primary optical axis to form a plurality of first virtual images of said electron source respectively,

wherein said transfer lens images said plurality of first virtual images onto an intermediate image plane and therefore forms a plurality of second real images respectively thereon, said field lens is placed on said intermediate image plane and bends said plurality of beamlets, said objective lens images said plurality of second real images onto said surface and therefore forms a plurality of probe spots thereon respectively, and 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,

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

wherein bending angles of said plurality of beamlets due to said field lens are set to reduce off-axis aberrations of said plurality of probe spots; and

wherein deflection angles of said plurality of beamlets due to said plurality of electron optics elements are adjusted to change pitches of said plurality of probe spots respectively.

37. The apparatus according to claim 36, wherein said objective lens comprises a first magnetic lens and a first electrostatic lens.

38. The apparatus according to claim 37, wherein an orientation of said plurality of probe spots is selectable by varying a ratio of focusing powers of said first magnetic lens and said first electrostatic lens.

39. The apparatus according to claim 36, wherein said transfer lens comprises a second magnetic lens and a second electrostatic lens.

40. The apparatus according to claim 39, wherein an orientation of said plurality of probe spots is selectable by varying a ratio of focusing powers of said second magnetic lens and said second electrostatic lens.

41. The apparatus according to claim 36, wherein said field lens comprises a third magnetic lens and a third electrostatic lens.

42. The apparatus according to claim 41, wherein an orientation of said plurality of probe spots is selectable by varying a ratio of focusing powers of said third magnetic lens and said third electrostatic lens.

43. The apparatus according to claim 36, wherein said bending angles and deflection angles of said plurality of beamlets due to said plurality of electron optics elements ensure said plurality of beamlets to land on said surface perpendicularly or substantially perpendicularly.

44. The apparatus according to claim 36, wherein said bending angles and deflection angles of said plurality of beamlets due to said plurality of electron optics elements ensure said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.

45. The apparatus according to claim 43, wherein said deflection scanning unit is above a front focal plane of said objective lens.

46. The apparatus according to claim 45, wherein said deflection scanning unit tilts said plurality of beamlets to obliquely land on said surface with same or substantially same landing angles.