What is claimed is:

1. A method of fabricating a crystalline silicon ingot, comprising the steps of:

(a) loading a nucleation promotion layer onto a bottom of a mold, the mold itself defining a vertical direction;

(b) providing a silicon source on the nucleation promotion layer in the mold;

(c) heating the mold until the silicon source is melted into a silicon melt completely;

(d) controlling at least one thermal control parameter regarding the silicon melt continually to enable a plurality of silicon grains from the silicon melt to nucleate on the nucleation promotion layer and to grow in the vertical direction; and

(e) continuously controlling the at least one thermal control parameter to enable the silicon grains to continuously grow in the vertical direction until entirety of the silicon melt is solidified to obtain the crystalline silicon ingot, wherein the silicon grains that are immediately adjacent to the nucleation promotion layer have an average grain size of less than 10 mm.

2. The method according to claim 1, wherein an increment rate of the defect density of the silicon crystalline ingot in the vertical direction ranges from 0.01%/mm to 10%/mm.

3. The method according to claim 1, wherein the nucleation promotion layer is composed of a plurality of crystal particles with irregular shape, each of which has a particle size of less than 50 mm.

4. The method according to claim 3, wherein the plurality of the crystal particles comprise one selected from the group consisting of a poly-Si particle, a mono-Si particle, and a single crystal silicon carbide.

5. The method according to claim 3, wherein the plurality of the crystal particles comprise a poly-Si particle or a mono-Si particle, and in step (c), the portions of the crystal particles are melted.

6. The method according to claim 1, wherein the nucleation promotion layer is a plate made of a material having a melting point higher than 1400℃, and the surface of the plate contacting the silicon melt has a roughness of 300 μm to 1000 μm for providing the plurality of the silicon grains with multiple nucleation sites.

7. The method according to claim 1, wherein dominant crystal orientations in the silicon grains are between (001) and (111), and a volume percentage of the silicon grains with the dominant crystal orientations is greater than 50%.

8. The method according to claim 1, wherein dominant crystal orientations in the silicon grains are between (001) and (111), and a volume percentage of the silicon grains with the dominant crystal orientations is greater than 70%.

9. A crystalline silicon ingot having a bottom and defining a vertical direction, characterized in that:

the crystalline silicon ingot comprises a plurality of silicon grains grown in the vertical direction and a nucleation promotion layer on the bottom, wherein the silicon grains that are adjacent to the nucleation promotion layer have an average grain size of less than 10 mm.

10. The crystalline silicon ingot according to claim 9, wherein an increment rate of defect density of the silicon crystalline ingot in the vertical direction ranges from 0.01%/mm to 10%/mm.

11. The crystalline silicon ingot according to claim 9, wherein the nucleation promotion layer is composed of a plurality of crystal particles with irregular shape, each of which has a particle size of less than 50 mm.

12. The crystalline silicon ingot according to claim 11, wherein the plurality of the crystal particles include one selected from the group consisting of a poly-Si particle, a mono-Si particle, and a single crystal silicon carbide.

13. The crystalline silicon ingot according to claim 9, wherein the nucleation promotion layer is a plate made of a material having a melting point higher than 1400℃, and the surface of the plate contacting the silicon melt has a roughness of 300 μm to 1000 μm for providing the plurality of the silicon grains with multiple nucleation sites.

14. The crystalline silicon ingot according to claim 9, wherein dominant crystal orientations in the silicon grains are between (001) and (111), and a volume percentage of the silicon grains with the dominant crystal orientations is greater than 50%.

15. The crystalline silicon ingot according to claim 9, wherein dominant crystal orientations in the silicon grains are between (001) and (111), and a volume percentage of the silicon grains with the dominant crystal orientations is greater than 70%.

16. A crystalline silicon ingot having a bottom and defining a vertical direction, characterized in that:

the crystalline silicon ingot comprises a plurality of silicon grains grown in the vertical direction and a nucleation promotion layer on the bottom, wherein the silicon grains that are adjacent to the nucleation promotion layer have an average grain size increasing in the vertical direction and

have at least three crystal orientations.

17. The crystalline silicon ingot according to claim 16, wherein the average grain size increasing two to three-fold larger in the vertical direction.

18. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of from 50 mm to 100 mm of the crystalline silicon ingot has the average grain size of from 7.4 mm to 13 mm.

19. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of from 100 mm to 200 mm of the crystalline silicon ingot has the average grain size of from 13 mm to 17.6 mm.

20. The crystalline ingot according to claim 16, wherein a slice sampled at the height of from 200 mm to 250 mm of the crystalline silicon ingot has the average grain size of from 17.6 mm to 18.4 mm.

21. The crystalline ingot according to claim 16, wherein the silicon grains that are adjacent to the nucleation promotion layer have an average grain size of less than 10 mm.

22. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of from 150 mm to 250 mm of the crystalline silicon ingot has a defect density of less than 15%.

23. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of 100 mm below of the crystalline silicon ingot has a defect density of less than 5%.

24. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of 150 mm below of the crystalline silicon ingot has a defect density of less than 10%.

25. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of 250 mm below of the crystalline silicon ingot has a defect density of less than 15%.

26. The crystalline silicon ingot according to any of claims 16-25, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is between 25% and 30%.

27. The crystalline silicon ingot according to any of claims 16-25, wherein the at least three crystal orientations comprise (112), (113) and (115).

28. The crystalline silicon ingot according to claim 27, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with the crystal orientations (113) or (115).

29. The crystalline silicon ingot according to claim 27, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (113).

30. The crystalline silicon ingot according to claim 27, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113) and (115) is greater than 45%.

31. The crystalline silicon ingot according to claim 27, wherein the at least three crystal orientations further comprise (001) and (111).

32. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (111) is greater than that of the silicon grains with the crystal orientations (113).

33. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 50%.

34. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 70%.

35. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with any of the crystal orientations (001), (111), (113) and (115).

36. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientation (111).

37. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (001) is less than that of the silicon grains with any of the crystal orientations (111), (112), (113) and (115).

38. The crystalline silicon ingot according to any of claims 17-26, wherein the nucleation promotion layer is composed of a plurality of crystal particles with irregular shape, each of which has a particle size of less than 50 mm.

39. The crystalline silicon ingot according to claim 38, wherein the plurality of the crystal particles comprise one selected from the group consisting of a poly-Si particle, a mono-Si particle, and a single crystal silicon carbide.

40. The crystalline silicon ingot according to any of claims 17-26, wherein the nucleation promotion layer is composed of a plurality of poly-Si chucks or mono-Si chucks.

41. The crystalline silicon ingot according to any of claims 17-26, wherein the nucleation promotion layer is a plate made of a material having a melting point higher than about 1400℃, and the surface of the plate contacting the silicon grains has a roughness of 300 μm to 1000 μm for providing the plurality of the silicon grains with multiple nucleation sites.

42. A crystalline silicon ingot having a bottom and defining a vertical direction, characterized in that:

the crystalline silicon ingot comprises a plurality of silicon grains grown in the vertical direction, a nucleation promotion layer on the bottom and a bottom region above the bottom, wherein the silicon grains have at least three crystal orientations, a slice sampled at the height of from 150 mm to 250 mm of the crystalline silicon ingot has a defect density of less than 15%.

43. The crystalline silicon ingot according to claim ~~40~~42, wherein a slice sampled below ~~at the height of~~ 100 mm ~~below~~ of the height of the crystalline silicon ingot has a defect density of less than 5%.

44. The crystalline silicon ingot according to claim ~~40~~42, wherein a slice sampled below ~~at the height of~~ 150 mm ~~below~~ of the height of the crystalline silicon ingot has a defect density of less than 10%.

45. The crystalline silicon ingot according to claim ~~40~~42, wherein a slice sampled ~~at~~ below ~~the height of~~ 250 mm ~~below~~ of the height of the crystalline silicon ingot has a defect density of less than 15%.

46. The crystalline silicon ingot according to any of claims 42-45, wherein a slice sampled above the bottom has the plurality of silicon grains with the crystal orientation (112) and the volume percentage of from 25% to 30%.

47. The crystalline silicon ingot according to any of claims 42-45, wherein the at least three crystal orientations comprise (112), (113) and (115).

48. The crystalline silicon ingot according to claim 47, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with the crystal orientations (113) or (115).

49. The crystalline silicon ingot according to claim 47, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (113).

50. The crystalline silicon ingot according to claim 47, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113) and (115) is greater than 45%.

51. The crystalline silicon ingot according to claim 47, wherein the at least three crystal orientations further comprise (001) and (111).

52. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 50%.

53. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 70%.

54. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with any of the crystal orientations (001), (111), (113) and (115).

55. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (111).

56. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (111) is greater than that of the silicon grains with the crystal orientations (113).

57. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (001) is less than that of the silicon grains with any of the crystal orientations (111), (112), (113) and (115).

58. The crystalline silicon ingot according to any of claims 42-45, wherein the nucleation promotion layer is composed of a plurality of crystal particles with irregular shape, each of which has a particle size of less than 50 mm.

59. The crystalline silicon ingot according to claim 58, wherein the plurality of the crystal particles comprise one selected from the group consisting of a poly-Si particle, a mono-Si particle, and a single crystal silicon carbide.

60. The crystalline silicon ingot according to any of claims 42-45, wherein the nucleation promotion layer is composed of a plurality of poly-Si chucks or mono-Si chucks.

61. The crystalline silicon ingot according to any of claims 42-45, wherein the nucleation promotion layer is a plate made of a material having a melting point higher than about 1400℃, and the surface of the plate contacting the silicon grains has a roughness of 300 μm to 1000 μm for providing the plurality of the silicon grains with multiple nucleation sites.

62. A poly-Si wafer, characterized in that:

the poly-Si wafer comprises a plurality of silicon grains having at least three crystal orientations which include (113) and (115), the volume percentage of the silicon grains with the crystal orientations (113) and (115) is between 20% and 35%.

63. The poly-Si wafer according to claim 62, wherein the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (113).

64. The poly-Si wafer according to claim 62, wherein the crystal orientations of the plurality of silicon grains further include (112), and the volume percentage of the silicon grains with the crystal orientation (112) is between 25% and 30%.

65. The poly-Si wafer according to claim 62, wherein the crystal orientations of the plurality of silicon grains further include (112).

66. The poly-Si wafer according to claims 64 or 65, wherein the volume percentage of the silicon grains with the crystal orientations (112), (113) and (115) is greater than 45%.

67. The poly-Si wafer according to claims 64 or 65, wherein the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with the crystal orientations (113) or (115).

68. The poly-Si wafer according to claims 64 or 65, wherein the crystal orientations of the plurality of silicon grains further include (001) and (111).

69. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientation (111) is greater than that of the silicon grains with the crystal orientations (113).

70. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 50%.

71. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 70%.

72. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with any of the crystal orientations (001), (111), (113) and (115).

73. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (111).

74. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientation (001) is less than that of the silicon grains with any of the crystal orientations (111), (112), (113) and (115).

75. The poly-Si wafer according to claim 62, wherein the silicon grains have an average grain size of less than 10 mm.

76. The poly-Si wafer according to claim 62, wherein the silicon grains have the average grain size of from 7.4 mm to 18.4 mm.

77. The poly-Si wafer according to claim 62, wherein the silicon grains have a defect density of less than 15%.

What is claimed is:

1. A method of fabricating a crystalline silicon ingot, comprising the steps of:

(a) loading a nucleation promotion layer onto a bottom of a mold, the mold itself defining a vertical direction;

(b) providing a silicon source on the nucleation promotion layer in the mold;

(c) heating the mold until the silicon source is melted into a silicon melt completely;

(d) controlling at least one thermal control parameter regarding the silicon melt continually to enable a plurality of silicon grains from the silicon melt to nucleate on the nucleation promotion layer and to grow in the vertical direction; and

(e) continuously controlling the at least one thermal control parameter to enable the silicon grains to continuously grow in the vertical direction until entirety of the silicon melt is solidified to obtain the crystalline silicon ingot, wherein the silicon grains that are immediately adjacent to the nucleation promotion layer have an average grain size of less than 10 mm.

2. The method according to claim 1, wherein an increment rate of the defect density of the silicon crystalline ingot in the vertical direction ranges from 0.01%/mm to 10%/mm.

3. The method according to claim 1, wherein the nucleation promotion layer is composed of a plurality of crystal particles with irregular shape, each of which has a particle size of less than 50 mm.

4. The method according to claim 3, wherein the plurality of the crystal particles comprise one selected from the group consisting of a poly-Si particle, a mono-Si particle, and a single crystal silicon carbide.

5. The method according to claim 3, wherein the plurality of the crystal particles comprise a poly-Si particle or a mono-Si particle, and in step (c), the portions of the crystal particles are melted.

6. The method according to claim 1, wherein the nucleation promotion layer is a plate made of a material having a melting point higher than 1400℃, and the surface of the plate contacting the silicon melt has a roughness of 300 μm to 1000 μm for providing the plurality of the silicon grains with multiple nucleation sites.

7. The method according to claim 1, wherein dominant crystal orientations in the silicon grains are between (001) and (111), and a volume percentage of the silicon grains with the dominant crystal orientations is greater than 50%.

8. The method according to claim 1, wherein dominant crystal orientations in the silicon grains are between (001) and (111), and a volume percentage of the silicon grains with the dominant crystal orientations is greater than 70%.

9. A crystalline silicon ingot having a bottom and defining a vertical direction, characterized in that:

the crystalline silicon ingot comprises a plurality of silicon grains grown in the vertical direction and a nucleation promotion layer on the bottom, wherein the silicon grains that are adjacent to the nucleation promotion layer have an average grain size of less than 10 mm.

10. The crystalline silicon ingot according to claim 9, wherein an increment rate of defect density of the silicon crystalline ingot in the vertical direction ranges from 0.01%/mm to 10%/mm.

11. The crystalline silicon ingot according to claim 9, wherein the nucleation promotion layer is composed of a plurality of crystal particles with irregular shape, each of which has a particle size of less than 50 mm.

12. The crystalline silicon ingot according to claim 11, wherein the plurality of the crystal particles include one selected from the group consisting of a poly-Si particle, a mono-Si particle, and a single crystal silicon carbide.

13. The crystalline silicon ingot according to claim 9, wherein the nucleation promotion layer is a plate made of a material having a melting point higher than 1400℃, and the surface of the plate contacting the silicon melt has a roughness of 300 μm to 1000 μm for providing the plurality of the silicon grains with multiple nucleation sites.

14. The crystalline silicon ingot according to claim 9, wherein dominant crystal orientations in the silicon grains are between (001) and (111), and a volume percentage of the silicon grains with the dominant crystal orientations is greater than 50%.

15. The crystalline silicon ingot according to claim 9, wherein dominant crystal orientations in the silicon grains are between (001) and (111), and a volume percentage of the silicon grains with the dominant crystal orientations is greater than 70%.

16. A crystalline silicon ingot having a bottom and defining a vertical direction, characterized in that:

the crystalline silicon ingot comprises a plurality of silicon grains grown in the vertical direction and a nucleation promotion layer on the bottom, wherein the silicon grains that are adjacent to the nucleation promotion layer have an average grain size increasing in the vertical direction and

have at least three crystal orientations.

17. The crystalline silicon ingot according to claim 16, wherein the average grain size increasing two to three-fold larger in the vertical direction.

18. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of from 50 mm to 100 mm of the crystalline silicon ingot has the average grain size of from 7.4 mm to 13 mm.

19. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of from 100 mm to 200 mm of the crystalline silicon ingot has the average grain size of from 13 mm to 17.6 mm.

20. The crystalline ingot according to claim 16, wherein a slice sampled at the height of from 200 mm to 250 mm of the crystalline silicon ingot has the average grain size of from 17.6 mm to 18.4 mm.

21. The crystalline ingot according to claim 16, wherein the silicon grains that are adjacent to the nucleation promotion layer have an average grain size of less than 10 mm.

22. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of from 150 mm to 250 mm of the crystalline silicon ingot has a defect density of less than 15%.

23. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of 100 mm below of the crystalline silicon ingot has a defect density of less than 5%.

24. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of 150 mm below of the crystalline silicon ingot has a defect density of less than 10%.

25. The crystalline silicon ingot according to claim 16, wherein a slice sampled at the height of 250 mm below of the crystalline silicon ingot has a defect density of less than 15%.

26. The crystalline silicon ingot according to any of claims 16-25, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is between 25% and 30%.

27. The crystalline silicon ingot according to any of claims 16-25, wherein the at least three crystal orientations comprise (112), (113) and (115).

28. The crystalline silicon ingot according to claim 27, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with the crystal orientations (113) or (115).

29. The crystalline silicon ingot according to claim 27, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (113).

30. The crystalline silicon ingot according to claim 27, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113) and (115) is greater than 45%.

31. The crystalline silicon ingot according to claim 27, wherein the at least three crystal orientations further comprise (001) and (111).

32. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (111) is greater than that of the silicon grains with the crystal orientations (113).

33. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 50%.

34. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 70%.

35. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with any of the crystal orientations (001), (111), (113) and (115).

36. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientation (111).

37. The crystalline silicon ingot according to claim 31, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (001) is less than that of the silicon grains with any of the crystal orientations (111), (112), (113) and (115).

38. The crystalline silicon ingot according to any of claims 17-26, wherein the nucleation promotion layer is composed of a plurality of crystal particles with irregular shape, each of which has a particle size of less than 50 mm.

39. The crystalline silicon ingot according to claim 38, wherein the plurality of the crystal particles comprise one selected from the group consisting of a poly-Si particle, a mono-Si particle, and a single crystal silicon carbide.

40. The crystalline silicon ingot according to any of claims 17-26, wherein the nucleation promotion layer is composed of a plurality of poly-Si chucks or mono-Si chucks.

41. The crystalline silicon ingot according to any of claims 17-26, wherein the nucleation promotion layer is a plate made of a material having a melting point higher than about 1400℃, and the surface of the plate contacting the silicon grains has a roughness of 300 μm to 1000 μm for providing the plurality of the silicon grains with multiple nucleation sites.

42. A crystalline silicon ingot having a bottom and defining a vertical direction, characterized in that:

the crystalline silicon ingot comprises a plurality of silicon grains grown in the vertical direction, a nucleation promotion layer on the bottom and a bottom region above the bottom, wherein the silicon grains have at least three crystal orientations, a slice sampled at the height of from 150 mm to 250 mm of the crystalline silicon ingot has a defect density of less than 15%.

43. The crystalline silicon ingot according to claim 42, wherein a slice sampled below 100 mm of the height of the crystalline silicon ingot has a defect density of less than 5%.

44. The crystalline silicon ingot according to claim 42, wherein a slice sampled below 150 mm of the height of the crystalline silicon ingot has a defect density of less than 10%.

45. The crystalline silicon ingot according to claim 42, wherein a slice sampled below 250 mm of the height of the crystalline silicon ingot has a defect density of less than 15%.

46. The crystalline silicon ingot according to any of claims 42-45, wherein a slice sampled above the bottom has the plurality of silicon grains with the crystal orientation (112) and the volume percentage of from 25% to 30%.

47. The crystalline silicon ingot according to any of claims 42-45, wherein the at least three crystal orientations comprise (112), (113) and (115).

48. The crystalline silicon ingot according to claim 47, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with the crystal orientations (113) or (115).

49. The crystalline silicon ingot according to claim 47, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (113).

50. The crystalline silicon ingot according to claim 47, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113) and (115) is greater than 45%.

51. The crystalline silicon ingot according to claim 47, wherein the at least three crystal orientations further comprise (001) and (111).

52. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 50%.

53. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 70%.

54. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with any of the crystal orientations (001), (111), (113) and (115).

55. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (111).

56. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (111) is greater than that of the silicon grains with the crystal orientations (113).

57. The crystalline silicon ingot according to claim 51, wherein in a slice sampled at the bottom above, the volume percentage of the silicon grains with the crystal orientation (001) is less than that of the silicon grains with any of the crystal orientations (111), (112), (113) and (115).

58. The crystalline silicon ingot according to any of claims 42-45, wherein the nucleation promotion layer is composed of a plurality of crystal particles with irregular shape, each of which has a particle size of less than 50 mm.

59. The crystalline silicon ingot according to claim 58, wherein the plurality of the crystal particles comprise one selected from the group consisting of a poly-Si particle, a mono-Si particle, and a single crystal silicon carbide.

60. The crystalline silicon ingot according to any of claims 42-45, wherein the nucleation promotion layer is composed of a plurality of poly-Si chucks or mono-Si chucks.

61. The crystalline silicon ingot according to any of claims 42-45, wherein the nucleation promotion layer is a plate made of a material having a melting point higher than about 1400℃, and the surface of the plate contacting the silicon grains has a roughness of 300 μm to 1000 μm for providing the plurality of the silicon grains with multiple nucleation sites.

62. A poly-Si wafer, characterized in that:

the poly-Si wafer comprises a plurality of silicon grains having at least three crystal orientations which include (113) and (115), the volume percentage of the silicon grains with the crystal orientations (113) and (115) is between 20% and 35%.

63. The poly-Si wafer according to claim 62, wherein the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (113).

64. The poly-Si wafer according to claim 62, wherein the crystal orientations of the plurality of silicon grains further include (112), and the volume percentage of the silicon grains with the crystal orientation (112) is between 25% and 30%.

65. The poly-Si wafer according to claim 62, wherein the crystal orientations of the plurality of silicon grains further include (112).

66. The poly-Si wafer according to claims 64 or 65, wherein the volume percentage of the silicon grains with the crystal orientations (112), (113) and (115) is greater than 45%.

67. The poly-Si wafer according to claims 64 or 65, wherein the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with the crystal orientations (113) or (115).

68. The poly-Si wafer according to claims 64 or 65, wherein the crystal orientations of the plurality of silicon grains further include (001) and (111).

69. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientation (111) is greater than that of the silicon grains with the crystal orientations (113).

70. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 50%.

71. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientations (112), (113), (115), (001) and (111) is greater than 70%.

72. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientation (112) is greater than that of the silicon grains with any of the crystal orientations (001), (111), (113) and (115).

73. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientation (115) is greater than that of the silicon grains with the crystal orientations (111).

74. The poly-Si wafer according to claim 68, wherein the volume percentage of the silicon grains with the crystal orientation (001) is less than that of the silicon grains with any of the crystal orientations (111), (112), (113) and (115).

75. The poly-Si wafer according to claim 62, wherein the silicon grains have an average grain size of less than 10 mm.

76. The poly-Si wafer according to claim 62, wherein the silicon grains have the average grain size of from 7.4 mm to 18.4 mm.

77. The poly-Si wafer according to claim 62, wherein the silicon grains have a defect density of less than 15%.