CLAIMS:

1. A method of preparing a single crystal silicon ingot by the Czochralski method, the method comprising:

adding an initial charge of polycrystalline silicon to a crucible contained within a growth chamber, wherein the crucible comprises a bottom wall and a sidewall and further wherein the growth chamber comprises a bottom heater located next to the bottom wall of the crucible, a side heater located next to the sidewall, and a reflector;

supplying power to the bottom heater, the side heater, or both the bottom heater and side heater to thereby heat the crucible comprising the initial charge of polycrystalline silicon to cause a silicon melt to form in the crucible, wherein the power supplied to the side heater is greater than the power supplied to the bottom heater, wherein the power supplied to the bottom heater is 2 kW or less, wherein the crucible is rotated at a rate between about 0.5 rpm and about 10 rpm, and further wherein the silicon melt has a free melt elevation level;

contacting a silicon seed crystal with the silicon melt contained within the crucible;

withdrawing the silicon seed crystal from the silicon melt in a direction perpendicular to the melt elevation level at an initial pull rate of between about 1.5 mm/min and about 6 mm/min to thereby form a solid neck portion of the single crystal silicon ingot, wherein the relative height between the free melt elevation level and a bottom of the reflector is between about 60 mm to about 120 mm during growth of the solid neck portion, and further wherein the silicon seed crystal is rotated at a rate between about 5 rpm and about 30 rpm during growth of the solid neck portion;

withdrawing a solid outwardly flaring seed-cone adjacent the neck portion of the single crystal silicon ingot from the silicon melt by modifying the initial pull rate to between about 0.5 mm/min and about 2 mm/min to thereby achieve an outwardly flaring seed-cone pull rate, wherein the relative height between the free melt elevation level and the bottom of the reflector is between about 60 mm to about 120 mm during growth of the solid outwardly flaring seed-cone; and

withdrawing a solid main body of the single crystal silicon ingot adjacent the outwardly flaring seed-cone from the silicon melt by modifying the outwardly flaring seed-cone pull rate to thereby achieve a main body pull rate, wherein the solid main body of the single crystal silicon ingot is pulled according to a pull rate protocol wherein the pull rate decreases from an initial pull rate of between about 0.5 mm/min and about 2.0 mm/min to a pull rate that may be as low as about 0.4 mm/min or as low as about 0.3 mm/min before increasing to a constant pull rate of between about 0.4 mm/min and about 0.8 mm/min, wherein the solid main body of the single crystal silicon ingot has a radius and an axial length and surface tension arising as the solid main body of the single crystal silicon ingot is withdrawn from the molten silicon results in a melt-solid interface located above the free melt elevation level and further wherein a meniscus comprising molten silicon is between the melt-solid interface and the free melt elevation level, wherein the relative height between the free melt elevation level and the bottom of the reflector is between 40 mm to 50 mm during growth of at least 50% of the solid main body of the single crystal silicon ingot, and further wherein the silicon seed crystal is rotated at a rate between about 5 rpm and about 10 rpm during growth of the solid main body of the single crystal silicon ingot;

wherein a cusp magnetic field is applied to the silicon melt during growth of the main body of the single crystal silicon ingot;

wherein the cusp magnetic field applied to the silicon melt during growth of the main body of the single crystal silicon ingot is derived from an upper magnetic coil and a lower magnetic coil, and further wherein an upper magnetic field strength derived from the upper magnetic coil is at least 10% greater than a lower magnetic field strength derived from the lower magnetic coil; and

wherein a heat flux in an axial direction between the melt-solid interface and the free melt elevation level during growth of at least 40% of a total axial length of the solid main body of the single crystal silicon ingot has an absolute value of at least about 20,000 W/m^2 over at least about 85% of the radius of the solid main body of the single crystal silicon ingot.

2. The method of claim 1 wherein the total axial length of the solid main body of the single crystal silicon ingot is at least about 1100 mm.

3. The method of claim 1 wherein the total axial length of the solid main body of the single crystal silicon ingot is between about 1200 mm and about 1300 mm.

4. The method of any one of claims 1 through 3 wherein the radius of the solid main body of the single crystal silicon ingot is about 75 mm, at least about 75 millimeters, about 100 mm, or at least about 100 millimeters.

5. The method of any one of claims 1 through 3 wherein the radius of the solid main body of the single crystal silicon ingot is about 150 mm or at least about 150 mm.

6. The method of any one of claims 1 through 5 wherein the heat flux in the axial direction between the melt-solid interface and the free melt elevation level during growth of at least 60% of the axial length of the solid main body of the single crystal silicon ingot has an absolute value of at least about 20,000 W/m^2 over at least about 85% of the radius of the solid main body of the single crystal silicon ingot.

7. The method of any one of claims 1 through 5 wherein the heat flux in the axial direction between the melt-solid interface and the free melt elevation level during growth of at least 80% of the axial length of the solid main body of the single crystal silicon ingot has an absolute value of at least about 20,000 W/m^2 over at least about 80% of the diameter of the solid main body of the single crystal silicon ingot.

8. The method of any one of claims 1 through 5 wherein the heat flux in the axial direction between the melt-solid interface and the free melt elevation level during growth of at least 90% of a total length of the solid main body of the single crystal silicon ingot has an absolute value of at least about 20,000 W/m^2 over at least about 85% of the radius of the solid main body of the single crystal silicon ingot.

9. The method of any one of claims 1 through 8 wherein a temperature gradient along a meniscus curve between the melt-solid interface and the free melt elevation level has an average value of at least about 0.16°C/mm during growth of at least 40% of a total length of the solid main body of the single crystal silicon ingot.

10. The method of any one of claims 1 through 8 wherein a temperature gradient along a meniscus curve between the melt-solid interface and the free melt elevation level has an average value of at least about 0.18°C/mm during growth of at least 40% of a total length of the solid main body of the single crystal silicon ingot.

11. The method of any one of claims 1 through 8 wherein a temperature gradient along a meniscus curve between the melt-solid interface and the free melt elevation level has an average value of at least about 0.16°C/mm during growth of at least 60% of a total length of the solid main body of the single crystal silicon ingot.

12. The method of any one of claims 1 through 8 wherein a temperature gradient along a meniscus curve between the melt-solid interface and the free melt elevation level has an average value of at least about 0.18°C/mm during growth of at least 60% of a total length of the solid main body of the single crystal silicon ingot.

13. The method of any one of claims 1 through 8 wherein a temperature gradient along a meniscus curve between the melt-solid interface and the free melt elevation level has an average value of at least about 0.16°C/mm during growth of at least 80% of a total length of the solid main body of the single crystal silicon ingot.

14. The method of any one of claims 1 through 8 wherein a temperature gradient along a meniscus curve between the melt-solid interface and the free melt elevation level has an average value of at least about 0.18°C/mm during growth of at least 80% of a total length of the solid main body of the single crystal silicon ingot.

15. The method of any one of claims 1 through 14 wherein a temperature of the molten silicon in the meniscus is at least 1691K as measured at the free melt elevation level during growth of at least 40% of a total length of the solid main body of the single crystal silicon ingot.

16. The method of any one of claims 1 through 14 wherein a temperature of the molten silicon in the meniscus is at least 1692K as measured at the free melt elevation level during growth of at least 40% of a total length of the solid main body of the single crystal silicon ingot.

17. The method of any one of claims 1 through 14 wherein a temperature of the molten silicon in the meniscus is at least 1691K as measured at the free melt elevation level during growth of at least 60% of a total length of the solid main body of the single crystal silicon ingot.

18. The method of any one of claims 1 through 14 wherein a temperature of the molten silicon in the meniscus is at least 1692K as measured at the free melt elevation level during growth of at least 60% of a total length of the solid main body of the single crystal silicon ingot.

19. The method of any one of claims 1 through 14 wherein a temperature of the molten silicon in the meniscus is at least 1691K as measured at the free melt elevation level during growth of at least 85% of a total length of the solid main body of the single crystal silicon ingot.

20. The method of any one of claims 1 through 14 wherein a temperature of the molten silicon in the meniscus is at least 1692K as measured at the free melt elevation level during growth of at least 85% of the axial length of the solid main body of the single crystal silicon ingot.

21. The method of any one of claims 1 through 20 wherein the upper magnetic field strength derived from the upper magnetic coil is at least 15% greater than the lower magnetic field strength derived from the lower magnetic coil.

22. The method of any one of claims 1 through 21 wherein, after growth of the neck and crown, the relative height between the free melt elevation level and the bottom of the reflector is decreased at a rate of at least -0.05 millimeter per millimeter of ingot growth.

23. The method of any one of claims 1 through 21 wherein, after growth of the neck and crown, the relative height between the free melt elevation level and the bottom of the reflector is decreased at a rate of less than about -0.1 millimeter per millimeter of ingot growth.