CLAIMS:

1. A method for forming a silicon substrate with reduced grown-in nuclei for epitaxial defects, the silicon substrate being boron doped, the method comprising:

adding an initial charge of polycrystalline silicon to a crucible;

heating the crucible comprising the initial charge of polycrystalline silicon to cause a silicon melt to form in the crucible;

adding boron to the crucible to produce a doped silicon melt;

contacting a silicon seed crystal with the doped silicon melt;

withdrawing the silicon seed crystal to grow a single crystal silicon ingot, the ingot having a constant diameter portion,

wherein a segment which is a part of the constant diameter portion of the ingot has a boron concentration from 2.8×10^{18} atoms/cm^3 to 5.4×10^{18} atoms/cm^3;

controlling (i) a growth velocity, v, and/or (ii) an axial temperature gradient, G, during the growth of the segment such that v/G is less than 0.20 mm^2/(min*K); and

cooling the segment of the constant diameter portion of the ingot from its solidification temperature to 950°C or less, wherein the dwell time the segment of the constant diameter portion of the ingot is in the temperature range from 1150°C to 950°C is less than 160 minutes.

2. The method as set forth in claim 1 wherein the constant diameter portion has a length D, the length of the segment being at least 0.5*D.

3. The method as set forth in claim 1 or claim 2 wherein the dwell time the segment of the constant diameter portion of the ingot is in the temperature range from 1150°C to 950°C is less than 120 minutes.

4. The method as set forth in any one of claims 1 to 3 wherein the melt is not doped with carbon.

5. The method as set forth in any one of claims 1 to 4 further comprising slicing the single crystal silicon ingot into substrates.

6. A method for preparing an epitaxial structure, the method comprising:

forming a silicon substrate by the method of any one of claims 1 to 5; and

contacting a front surface of the silicon substrate with a silicon-containing gas, the silicon-containing gas decomposing to form an epitaxial silicon layer on the silicon substrate.

7. A method for forming a silicon substrate with reduced grown-in nuclei for epitaxial defects, the method comprising:

adding an initial charge of polycrystalline silicon to a crucible;

heating the crucible comprising the initial charge of polycrystalline silicon to cause a silicon melt to form in the crucible;

adding boron to the crucible to prepare a doped silicon melt having a boron concentration of at least 3.8 x 10^{18} atoms/cm^3;

contacting a silicon seed crystal with the doped silicon melt;

withdrawing the silicon seed crystal to grow a single crystal silicon ingot, the ingot having a constant diameter portion;

controlling (i) a growth velocity, v, and/or (ii) an axial temperature gradient, G, during the growth of a segment of the constant diameter portion of the ingot such that the ratio v/G is less than a critical v/G and interstitials are the dominant intrinsic point defect in the segment; and

cooling the segment of the constant diameter portion of the ingot from its solidification temperature to 950°C or less, wherein the dwell time the segment of the constant diameter portion of the ingot is in the temperature range from 1150°C to 950°C is less than 160 minutes.

8. The method as set forth in claim 7 wherein the constant diameter portion has a length D, the length of the segment being at least 0.5*D.

9. The method as set forth in claim 7 or claim 8 wherein the dwell time the segment of the constant diameter portion of the ingot is in the temperature range from 1150°C to 950°C is less than 120 minutes.

10. The method as set forth in any one of claims 7 to 9 wherein:

when the concentration of boron in the segment of the constant diameter portion is from 2.8 x 10^{18} atoms/cm^3 to 5.4 x 10^{18} atoms/cm^3, the (i) a growth velocity, v, and/or (ii) an axial temperature gradient, G, is controlled such that v/G is less than 0.20 mm^2/(min*K); and

when the concentration of boron in the segment of the constant diameter portion is from 5.4 x 10^{18} atoms/cm^3 to 8.0 x 10^{18} atoms/cm^3, the (i) a growth velocity, v, and/or (ii) an axial temperature gradient, G, is controlled such that v/G is less than 0.25 mm^2/(min*K).

11. The method as set forth in any one of claims 7 to 10 wherein the melt is not doped with carbon.

12. The method as set forth in any one of claims 7 to 11 further comprising slicing the single crystal silicon ingot into substrates.

13. A method for preparing an epitaxial structure, the method comprising:

forming a silicon substrate by the method of any one of claims 7 to 12; and

contacting a front surface of the silicon substrate with a silicon-containing gas, the silicon-containing gas decomposing to form an epitaxial silicon layer on the silicon substrate.