What is claimed is:

1. A method of treating a substrate, comprising:

delivering a first melt energy pulse to the substrate from a first energy generator;

delivering a second melt energy pulse to the substrate from a second energy generator;

after a first freeze period, delivering a first freeze control energy pulse to the substrate from a third energy generator;

after a second freeze period, delivering a second freeze control energy pulse to the substrate from a fourth energy generator.

2. The method of claim 1, wherein the first freeze period has a duration less than a time for a temperature of the molten area to fall below a nucleation point.

3. The method of claim 1, wherein the first freeze control energy pulse has an energy content that increases a temperature of the molten area above a nucleation point.

4. The method of claim 1, wherein the first freeze period and the second freeze period are selected to form a large crystal area and a small crystal area.

5. The method of claim 4, wherein the first and second freeze control energy pulses each have a total energy content that melts the small crystal area.

6. The method of claim 1, wherein a first refrozen portion is formed during the first freeze period, and a temperature of the first refrozen portion is not more than about 200°C when the first freeze control energy pulse is delivered.

7. The method of claim 6, wherein a second refrozen portion is formed during the second freeze period, and a temperature of the second refrozen portion is not more than about 200°C when the second freeze control energy pulse is delivered.

8. A method of thermally treating a substrate, comprising:

identifying a first treatment area of the substrate;

melting the first treatment area of the substrate by delivering a pulsed energy to the first treatment area;

resolidifying a first portion of the first treatment area to form a large crystal area and a small crystal area;

reorganizing the small crystal area by delivering a pulse of energy to the first treatment area;

repeating the resolidifying and the reorganizing until the first treatment area is a crystalline solid having large crystals of dimension at least about 8 μm;

identifying a subsequent treatment area substantially adjacent to the first treatment area; and

repeating the melting, resolidifying, reorganizing, repeating, and identifying until all desired treatment areas of the substrate have been processed.

9. The method of claim 8, wherein each treatment area is treated in about 5 μsec or less.

10. The method of claim 9, further comprising maintaining an ambient temperature of the substrate below about 100°C.

11. The method of claim 8, wherein the reorganizing the small crystal area comprises melting the small crystal area.

12. A method of crystallizing a semiconductor material, comprising:

delivering a first plurality of energy pulses to melt the semiconductor material; and

delivering a second plurality of energy pulses to control freezing of the semiconductor material, wherein the second plurality of energy pulses maintain a cooling rate in a boundary layer adjacent to a propagating freeze front that is no more than about 500 K/μsec.

13. A method of crystallizing a semiconductor material, comprising:

maintaining an ambient temperature of the substrate less than about 100°C;

identifying a treatment area of a semiconductor substrate;

performing a progressive melt process using pulsed energy on the treatment area; and

performing a crystallographic freeze process using pulsed energy on the treatment area.

14. The method of claim 13, wherein the crystallographic freeze process comprises directing energy pulses at a freeze front of the treatment area and maintaining an interface energy of the freeze front above an epitaxy point.

15. A method of processing a treatment area of a semiconductor substrate, the treatment area having large crystals and small crystals, the method comprising:

directing a first pulsed energy onto the treatment area, the first pulsed energy having energy content selected to initiate transformation of small crystals to large crystals; and

directing a second pulsed energy onto the treatment area, the second pulsed energy having energy content different from the first pulsed energy and selected to maintain the transformation of small crystals to large crystals.

16. The method of claim 15, wherein the second pulsed energy maintains explosive regrowth of the small crystals to large crystals.

17. The method of claim 15, where the second pulsed energy comprises a plurality of energy pulses that are timed to support the transformation by energy released from latent heat of crystallization.

18. The method of claim 15, wherein the second pulsed energy delivers energy to the treatment area less than a standard melting energy of the small crystals.

What is claimed is:

1. A method of processing a treatment area of a semiconductor substrate, the treatment area having large crystals and small crystals, the method comprising:

directing a first pulsed energy onto the treatment area, the first pulsed energy having energy content selected to initiate transformation of small crystals to large crystals; and

directing a second pulsed energy onto the treatment area, the second pulsed energy having energy content different from the first pulsed energy and selected to maintain the transformation of small crystals to large crystals, wherein the second pulsed energy delivers energy to the treatment area less than a standard melting energy of the small crystals.