What is claimed is:

1. An apparatus for thermally treating a semiconductor substrate, comprising:

a rotatable substrate support;

a radiation source capable of producing a beam of radiation having substantially uniform intensity proximate the rotatable substrate support, the beam of radiation emerging from the radiation source at a beam entry point;

a constant optical path length beam location assembly disposed in optical communication with the beam entry point, the constant optical path length beam location assembly having a plurality of movable optical components; and

a controller coupled to the substrate support and the constant optical path length beam location assembly, the controller adapted to position the optical components of the beam location assembly and a selected portion of a substrate on the substrate support such that the beam illuminates the selected portion and the optical path length for the beam is substantially the same for all portions of the substrate.

2. The apparatus of claim 1, wherein the movable optical components comprise a first mirror and a second mirror, the first mirror coupled to a first linear positioner and a first rotational positioner and the second mirror coupled to a second linear positioner and a second rotational positioner.

3. The apparatus of claim 2, wherein the first linear positioner is oriented in a first direction, the second linear positioner is oriented in the first direction, and each rotational positioner rotates about an axis perpendicular to the first direction.

4. The apparatus of claim 3, further comprising a third linear positioner coupled to the second mirror and oriented in a second direction perpendicular to the first direction, wherein each rotational positioner rotates about an axis perpendicular to the first direction and the second direction.

5. The apparatus of claim 4, wherein the radiation source comprises an actuated aperture coupled to the controller, and the controller is further adapted to position the aperture based on the position of the beam on the substrate.

6. The apparatus of claim 5, further comprising a beam position detector that sends a beam position signal to the controller.

7. The apparatus of claim 5, wherein the beam has a non-uniform cross-sectional shape, and the actuator of the final optical element of the light source rotates the aperture to orient the beam.

8. The apparatus of claim 6, wherein the beam position detector comprises a camera adapted to detect an intensity profile of the beam, the final optical element comprises a variable focus lens, and the controller is further adapted to adjust the variable focus lens based on the intensity profile of the beam.

9. A beam location assembly for a laser annealing chamber, comprising:

a beam targeting optical assembly;

a beam targeting detector; and

a controller adapted to sequentially target a beam of laser radiation to a plurality of locations with a substantially constant optical path length.

10. The beam location assembly of claim 9, wherein the beam targeting optical assembly comprises at least two actuated mirrors, the controller is coupled to the mirrors, and the controller is adapted to target the beam with substantially constant optical path length by moving the mirrors.

11. The beam location assembly of claim 9, further comprising an actuated entry aperture coupled to the controller, wherein the controller is adapted to target the beam by moving the aperture in a plane perpendicular to the direction of propagation of the beam of laser radiation.

12. The beam location assembly of claim 10 or 11, wherein the beam targeting detector comprises a CCD matrix.

13. A method of targeting a beam of laser radiation at a target location on a surface, the method comprising:

staging the target location by rotating the surface to an accessible orientation;

locating a beam capture mirror over the target location;

determining a reflection point of a beam steering mirror such that the optical path length of the beam reflecting from the beam steering mirror and the beam capture mirror to the surface is substantially equal to a target optical path length;

moving the beam steering mirror to the reflection point;

rotating the beam steering mirror to direct the beam to the beam capture mirror; and

rotating the beam capture mirror to direct the beam to the target location.

14. The method of claim 13, further comprising detecting the accuracy of the beam targeting and improving the beam targeting by adjusting a beam origin point.

Claims

1. An apparatus for thermally treating a semiconductor substrate, comprising:

a rotatable substrate support;

a radiation source capable of producing a beam of radiation having substantially uniform intensity proximate the rotatable substrate support, the beam of radiation emerging from the radiation source at a beam entry point;

a constant optical path length beam location assembly disposed in optical communication with the beam entry point, the constant optical path length beam location assembly having a plurality of movable optical components, wherein the movable optical components comprise a first mirror and a second mirror, the first mirror coupled to a first linear actuator and a first rotational actuator and the second mirror coupled to a second linear actuator and a second rotational actuator, wherein the first linear actuator moves the first mirror along a first direction and the second linear actuator moves the second mirror along the first direction; and

a controller coupled to the substrate support and the constant optical path length beam location assembly, the controller adapted to position the optical components of the beam location assembly and a selected portion of a substrate on the substrate support such that the beam illuminates the selected portion and the optical path length for the beam is substantially the same for all portions of the substrate.

2. The apparatus of claim 1, wherein each rotational actuator rotates about an axis perpendicular to the first direction.

3. The apparatus of claim 2, wherein the second mirror also moves along a second direction perpendicular to the first direction, wherein each rotational actuator rotates about an axis perpendicular to the first direction and the second direction.

4. The apparatus of claim 3, wherein the radiation source comprises an actuated aperture coupled to the controller, and the controller is further adapted to position the aperture based on the position of the beam on the substrate.

5. The apparatus of claim 4, further comprising a beam position detector that sends a beam position signal to the controller.

6. The apparatus of claim 5, wherein the beam position detector comprises a camera.

7. The apparatus of claim 4, wherein the beam has a non-uniform cross-sectional shape, and the actuator of the final optical element of the light source rotates the aperture to orient the beam.

8. The apparatus of claim 6, wherein the camera detects an intensity profile of the beam, the final optical element comprises a variable focus lens, and the controller is further adapted to adjust the variable focus lens based on the intensity profile of the beam.

9. A method of targeting a beam of laser radiation at a target location on a surface, the method comprising:

staging the target location by rotating the surface to an accessible orientation;

locating a beam capture mirror over the target location;

determining a reflection point of a beam steering mirror such that an optical path length of the beam reflecting from the beam steering mirror and the beam capture mirror to the target location is substantially equal to a target optical path length;

moving the beam steering mirror in a first direction to the reflection point;

rotating the beam steering mirror to direct the beam to the beam capture mirror;

rotating the beam capture mirror to direct the beam to the target location; and

moving the beam capture mirror as necessary in a second direction that is perpendicular to the first direction and a third direction that is parallel to the first direction.

10. The method of claim 9, further comprising detecting the accuracy of the beam targeting and improving the beam targeting by adjusting a beam origin point.

11. The method of claim 9, wherein staging the target location, locating the beam capture mirror over the target location, moving the beam steering mirror, and rotating the beam steering and beam capture mirrors is performed concurrently.

12. The method of claim 9, further comprising detecting the focus of the beam and improving the beam focus by adjusting a variable focus lens.

13. The method of claim 9, further comprising adjusting a beam orientation by rotating an aperture at a beam origin point.