CLAIMS

What is claimed is:

1. A method of completely removing structures or materials deposited, implanted, or formed in or on a surface of a semiconductor substrate without chemicals comprising:

    focusing coherent light on the surface of the substrate, wherein the coherent light has a predetermined wavelength, power, pulse width, and pulse rate or number of pulses per unit area that causes direct ionic vaporization of metals, dielectrics, and semiconducting materials deposited, implanted, or formed in or on the surface of the substrate up to a predetermined penetration depth with minimally acceptable damage to the crystalline substrate;

    purging the surface of the substrate with an inert purge gas or liquid; and

    exhausting the surface of the substrate,

    wherein the substrate is free from heavy metal surface contamination and has a surface roughness capable of being polished back to a mirror-like finish.

2. The method of claim 1, further comprising:

    disposing the substrate on a substrate holder;

    disposing the substrate holder on a substrate staging system; and

    controlling an environment of the substrate to a predetermined pressure.

3. The method of claim 1, further comprising:

    directing the coherent light through a moveable lens or mirror.

4. The method of claim 1, further comprising:

moving the substrate to ensure one or more surfaces of the substrate are exposed to the coherent light.

5. The method of claim 1, further comprising:

rotating the substrate to ensure one or more surfaces of the substrate are exposed to the coherent light.

6. The method of claim 1, further comprising:

moving a coherent light source or a mirror to ensure one or more surfaces of the substrate are exposed to the coherent light.

7. The method of claim 1, further comprising:

inspecting a surface roughness of one or more surfaces of the substrate for compliance.

8. The method of claim 1, further comprising:

inspecting a final thickness of the substrate for compliance.

9. The method of claim 1, further comprising:

inspecting the ionic vaporized surface of the substrate for compliance.

10. The method of claim 1, wherein the substrate is disposed within a vacuum chamber.

11. The method of claim 1, wherein a focal point is adjusted by moving the substrate or moving a coherent light source.

12. The method of claim 1, wherein a focal point is directed at a predetermined location on or within the surface of the substrate.

13. The method of claim 2, wherein the predetermined pressure is in a range between 1 and 2 atmospheres.

14. The method of claim 2, wherein the predetermined pressure is in a range between 1 millitorr and 1 atmosphere.

15. The method of claim 2, wherein the predetermined pressure is in a range between 10^{-7} torr and 1 millitorr.

16. The method of claim 1, wherein the coherent light is generated by a coherent light source comprising an ultraviolet laser.

17. The method of claim 1, wherein the coherent light is generated by a coherent light source comprising a visible light laser.

18. The method of claim 1, wherein the coherent light is generated by a coherent light source comprising an infrared laser.

19. The method of claim 1, wherein the coherent light is generated by a coherent light source comprising an excimer laser.

20. The method of claim 1, wherein the coherent light is generated by a coherent light source comprising an extreme ultraviolet source.

21. The method of claim 1, wherein the coherent light is generated by a coherent light source comprising a beam of light.

22. The method of claim 1, wherein the predetermined wavelength is in a range between 13.5 and 355 nanometers.

23. The method of claim 1, wherein the predetermined wavelength is in a range between 300 and 800 nanometers.

24. The method of claim 1, wherein the predetermined wavelength is in a range between 700 nanometers and 1.4 microns.

25. The method of claim 1, wherein the predetermined wavelength is in a range between 900 nanometers and 5 microns.

26. The method of claim 1, wherein the predetermined power is in a range between 1 and 1,000 watts.

27. The method of claim 1, wherein the predetermined pulse width is in a range between 10^{-6} and 10^{-18} seconds.

28. The method of claim 1, wherein the predetermined pulse rate is in a range between 1 and 50,000 Hertz.

29. The method of claim 1, wherein the predetermined penetration depth is in a range between 1 and 30 microns.

30. A system for completely removing structures or materials deposited, implanted, or formed in or on a surface of a semiconductor substrate without chemicals comprising:

a coherent light source that generates a coherent light having a predetermined wavelength, power, pulse width, and pulse rate or number of pulses per unit area that causes direct ionic vaporization of metals, dielectrics, and semiconducting materials deposited, implanted, or formed in or on the surface of the substrate up to a predetermined penetration depth with minimally acceptable damage to the crystalline substrate;

a lens or mirror that focuses the coherent light on the surface of the substrate;

a gas purging system that purges the surface of the substrate; and

an exhaust system that exhausts the substrate.