CLAIMS

1. A system for laser patterning a semiconductor device, comprising:

a diode-pumped solid-state laser source configured to generate a pulsed laser beam, the laser source comprising a slab gain medium, the laser source further characterized by:

a pulse energy between 0.25 mJ and 10 mJ;

a pulse width between 1 ns and 4000 ns; and

a pulse frequency between 1 kHz and 200 kHz;

a galvanometer optical scanner;

a first telecentric lens having a field of view (FOV) with lateral dimensions substantially equal to or greater than 137 mm, the first telecentric lens having a working distance between 30 mm and 500 mm; and

a second telecentric lens having FOV with lateral dimensions substantially equal to or greater than 137 mm and a working distance between 30 mm and 500 mm.

2. The system of claim 1, wherein the laser source is an infrared (IR) laser source.

3. The system of claim 1, wherein the first telecentric lens has a telecentric error value of less than 5°.

4. The system of claim 1, wherein the first telecentric lens is specific to IR wavelengths and the second telecentric lens is specific to UV wavelengths.

5. The system of claim 4, wherein the maximum telecentricity error and nominal spot size of the first and the second telecentric lenses are substantially the same.

6. The system of claim 1, further comprising a controller in communication with the laser source and the galvanometer optical scanner, the controller configured to modulate the pulse energy, the pulse width, and the pulse frequency of the laser source.

7. The system of claim 6, wherein the controller is further configured to modulate a pulse shape of the laser source.

8. The system of claim 7, the pulse shape of the laser source is rectangular or chair shaped.

9. The system of claim 6, further comprising an adjustable stage disposed on linear and parallel tracks.

10. The system of claim 9, wherein the adjustable stage is configured to receive a substrate having lateral dimensions of 156 mm or greater.

11. The system of claim 9, wherein the adjustable stage is coupled to a linear stage encoder to provide location information of the stage to the controller.

12. The system of claim 11, further comprising a camera pointed at the adjustable stage and in communication with the controller.

13. The system of claim 12, wherein the camera, the adjustable stage, and the controller form a closed loop calibration system for positional calibration of the galvanometer optical scanner.

14. The system of claim 1, further comprising a debris collector for creating a cross-flow of circulated gas in a processing region of the system.

15. A system for laser patterning a semiconductor device, comprising:

a diode-pumped solid-state laser source configured to generate a pulsed laser beam, the laser source comprising a slab gain medium, the laser source further characterized by:

a pulse energy between 0.25 mJ and 10 mJ;

a pulse width between 1 ns and 4000 ns; and

a pulse frequency between 1 kHz and 200 kHz;

a galvanometer optical scanner;

a first telecentric lens having a field of view (FOV) with lateral dimensions substantially equal to or greater than 137 mm, the telecentric lens having a working distance between 30 mm and 500 mm;

a second telecentric lens having FOV with substantially equal lateral dimensions to the first telecentric lens; and

an adjustable stage having bi-directional movement, the movement of the stage synchronized with a movement of the galvanometer optical scanner.

16. The system of claim 15, wherein the first telecentric lens has a telecentric error value of less than 5°.

17. The system of claim 15, wherein the first telecentric lens is specific to IR wavelengths and the second telecentric lens is specific to UV wavelengths.

18. A system for laser patterning a semiconductor device, comprising:

a diode-pumped solid-state laser source configured to generate a pulsed laser beam, the laser source comprising an infrared (IR) slab gain medium, the laser source further characterized by:

a pulse energy between 0.25 mJ and 10 mJ;

a pulse width between 1 ns and 4000 ns; and

a pulse frequency between 1 kHz and 200 kHz;

a galvanometer optical scanner;

a first telecentric lens having a field of view (FOV) with lateral dimensions substantially equal to or greater than 137 mm, the telecentric lens having a working distance between 30 mm and 500 mm;

a second telecentric lens having FOV with lateral dimensions substantially equal to or greater than 137 mm;

an adjustable stage having bi-directional movement, the stage configured to translate from a loading position to a processing position for laser patterning and an absolute position for calibration of the galvanometer optical scanner; and

a controller in communication with the laser source, the galvanometer optical scanner, and the adjustable stage, the controller configured to modulate the pulse energy, the pulse width, and the pulse frequency of the laser source.