CLAIMS

1. A method of directing an optic beam to a workpiece, the method comprising:

transmitting an optic beam through an acousto-optic deflector;

applying an acoustic signal with a phase delay across multiple transducers of the acousto-optic deflector to deflect the beam along a first axis by the acousto-optic deflector; and

directing the deflected beam onto a workpiece.

2. The method of Claim 1, further comprising deflecting the beam simultaneously along a second axis by the acousto-optic deflector.

3. The method of Claim 2, wherein the transducers are arranged in two dimensions and wherein applying the acoustic signal comprises applying the acoustic signal with a phase delay in the two dimensions of the transducers to control the deflection of the beam along the first and the second axis.

4. The method of Claim 1, wherein the workpiece is a substrate, the method further comprising focusing the deflected optic beam through magnification optics onto the substrate to drill vias on the substrate.

5. The method of Claim 1, the method further comprising adjusting the frequencies of the applied acoustic signal to control an angle of deflection of the optic beam.

6. The method of Claim 1, wherein the multiple transducers are along a single first surface of the acousto-optic deflector, the method further comprising applying a second acoustic signal to a second set of multiple transducers arranged on a second surface of the acousto-optic deflector, the first and the second surfaces being adjacent so that an acoustic wave in the crystal from the first surface combines with an acoustic wave in the crystal from the second surface.

7. The method of Claim 1, the method further comprising:

transmitting the optic beam through an aperture mask;

reflecting the transmitted (masked) optic beam by a mirror to the acousto-optic deflector;

positioning the workpiece on a surface so that the deflected optic beam is incident on the substrate; and

drilling vias on the substrate by the diffracted optic beam of the acousto-optic deflector.

8. A system, comprising:

an acousto-optic deflector having a first surface configured to receive a transmitted optic beam and a second surface;

a plurality of acoustic transducers on the second surface of the acousto-optic deflector;

an electrical input for the acoustic transducers configured to generate an acoustic frequency signal using the transducers with a selected phase delay between each transducer, and to apply the acoustic frequency signal to the acousto-optic deflector to control an angle of deflection of the optic beam along a first axis; and

imaging optics to direct the deflected optic beam to a workpiece.

9. The system of Claim 8, wherein the plurality of acoustic transducers are arranged in two dimensions and wherein the electric input is configured to generate an acoustic frequency signal using the transducers with two sets of selected phase delays between the transducers, the first set of phase delays being in a first of the two dimensions of the transducers and the second set of phase delays being in a second of the two dimensions of the transducers to simultaneously control a deflection of the optic beam along the first and the second axis.

10. The system of Claim 9, wherein the two dimensions of the transducers are orthogonal.

11. The system of Claim 9, wherein the transducers are arranged in a grid array with the transducers positioned in orthogonal rows.

12. The system of Claim 8, wherein the first and the second surfaces of the acousto-optic deflector are orthogonal.

13. The system of Claim 8, further comprising a second plurality of acoustic transducers on a third surface of the acousto-optic deflector, and wherein the electrical input is further applied to the second plurality of acoustic transducers to generate a second acoustic frequency signal with a selected phase delay between each transducer, and to apply the acoustic frequency signal to the acousto-optic deflector to control an angle of deflection of the optic beam also along a second axis.

14. The system of Claim 8, wherein the imaging optics comprises a telecentric lens.

15. The system of Claim 14, wherein the optic beam is to produce vias on the workpiece.

16. The system of Claim 14, wherein the optic beam is to expose a photo-resist material for laser direct imaging to fabricate a circuit on the workpiece.

17. The system of Claim 8, wherein the electrical input is adjusted to change acoustic frequencies across the transducers to control an angle of deflection of the optic beam.

18. The system of Claim 17, wherein the electrical input is adjusted by changing the phase delay between adjacent transducers.

19. The system of Claim 17, wherein the electrical input is adjusted by changing the power applied to the transducers.

20. The system of Claim 8, wherein the electrical input is adjusted to change acoustic frequencies across the transducers to achieve the Bragg condition for diffracting the optic beam under the Bragg condition.

21. The system of Claim 8, wherein the acousto-optic deflector comprises a germanium crystal.

22. The system of Claim 8, wherein the acousto-optic deflector comprises a tellurium dioxide crystal.

23. A system for via drilling on a substrate, the system comprising:

a laser resonator configured to generate a laser beam;

an aperture mask optically coupled to the laser resonator to shape the laser beam;

an acousto-optic deflector configured to receive the laser beam, and to steer the received laser beam in an intended direction;

an optical element to direct the steered laser beam; and

a workpiece support to which the steered laser beam is directed to work on a supported workpiece.

24. The system of Claim 23, wherein the acousto-optic deflector has a plurality of acoustic transducers on a surface of the acousto-optic deflector and wherein the transducers receive an acoustic frequency electric signal with a phase delay between the transducers to control the direction of the steered laser beam.

25. The system of Claim 24, wherein the plurality of acoustic transducers are arranged in two dimensions and wherein the electric input is configured to generate an acoustic frequency signal using the transducers with two sets of selected phase delays between the transducers, the first set of phase delays being in a first of the two dimensions of the transducers and the second set of phase delays being in a second of the two dimensions of the transducers to simultaneously control a deflection of the laser beam along the first and the second axis.

26. The system of Claim 24, wherein the acousto-optic deflector has a second plurality of acoustic transducers on a second surface of the acousto-optic deflector and wherein the second plurality of acoustic transducers receive a second acoustic frequency electric signal with a phase delay between the transducers to control the direction of the steered laser beam along a second axis.

27. The system of Claim 23, wherein work on the supported workpiece comprises drilling vias on the workpiece.

28. The system of Claim 23, wherein work on the supported workpiece comprises exposing a photoresist material for laser direct imaging.

29. The system of Claim 23, wherein electrical inputs to the transducers are adjusted to change acoustic frequencies to control an angle of diffraction to deflect the laser beam.

30. The system of Claim 23, wherein electrical inputs to the transducers are adjusted to change acoustic frequencies across the transducers to achieve the Bragg condition for deflecting the laser beam under the Bragg condition.

31. The system of Claim 23, further comprising multiple transducers are arranged on multiple faces of the acousto-optic deflector with certain angle between faces.

CLAIMS

1. A method comprising:

transmitting an optic beam through an acousto-optic deflector;

applying an acoustic signal with a phase delay across multiple transducers of the acousto-optic deflector to deflect the beam along a first axis by the acousto-optic deflector; and

directing the deflected beam onto a workpiece.

2. The method of Claim 1, further comprising deflecting the beam simultaneously along a second axis by the acousto-optic deflector.

3. The method of Claim 2, wherein the transducers are arranged in two dimensions and wherein applying the acoustic signal comprises applying the acoustic signal with a phase delay in the two dimensions of the transducers to control the deflection of the beam along the first and the second axis.

4. The method of Claim 1, wherein the multiple transducers are along a single first surface of the acousto-optic deflector, the method further comprising applying a second acoustic signal to a second set of multiple transducers arranged on a second surface of the acousto-optic deflector, the first and the second surfaces being adjacent so that an acoustic wave in the crystal from the first surface combines with an acoustic wave in the crystal from the second surface.

5. The method of Claim 1, the method further comprising:

transmitting the optic beam through an aperture mask;

reflecting the transmitted (masked) optic beam by a mirror to the acousto-optic deflector;

positioning the workpiece on a surface so that the deflected optic beam is incident on the substrate; and

drilling vias on the substrate by the diffracted optic beam of the acousto-optic deflector.

6. A system, comprising:

an acousto-optic deflector having a first surface configured to receive a transmitted optic beam and a second surface;

a plurality of acoustic transducers on the second surface of the acousto-optic deflector;

an electrical input for the acoustic transducers configured to generate an acoustic frequency signal using the transducers with a selected phase delay between each transducer, and to apply the acoustic frequency signal to the acousto-optic deflector to control an angle of deflection of the optic beam along a first axis; and

imaging optics to direct the deflected optic beam to a workpiece.

7. The system of Claim 6, wherein the plurality of acoustic transducers are arranged in two dimensions and wherein the electric input is configured to generate an acoustic frequency signal using the transducers with two sets of selected phase delays between the transducers, the first set of phase delays being in a first of the two dimensions of the transducers and the second set of phase delays being in a second of the two dimensions of the transducers to simultaneously control a deflection of the optic beam along the first and the second axis.

8. The system of Claim 7, wherein the transducers are arranged in a grid array with the transducers positioned in orthogonal rows.

9. The system of Claim 6, further comprising a second plurality of acoustic transducers on a third surface of the acousto-optic deflector, and wherein the electrical input is further applied to the second plurality of acoustic transducers to generate a second acoustic

frequency signal with a selected phase delay between each transducer, and to apply the acoustic frequency signal to the acousto-optic deflector to control an angle of deflection of the optic beam also along a second axis.

10. The system of Claim 6, wherein the electrical input is adjusted to change acoustic frequencies across the transducers to control an angle of deflection of the optic beam.

11. The system of Claim 10, wherein the electrical input is adjusted by changing the phase delay between adjacent transducers.

12. The system of Claim 10, wherein the electrical input is adjusted by changing the power applied to the transducers.

13. The system of Claim 6, wherein the electrical input is adjusted to change acoustic frequencies across the transducers to achieve the Bragg condition for diffracting the optic beam under the Bragg condition.

14. The system of Claim 6, wherein the acousto-optic deflector comprises a germanium crystal.

15. The system of Claim 6, wherein the acousto-optic deflector comprises a tellurium dioxide crystal.

16. A system comprising:

a laser resonator configured to generate a laser beam;

an aperture mask optically coupled to the laser resonator to shape the laser beam;

an acousto-optic deflector configured to receive the laser beam, and to steer the received laser beam in an intended direction;

an optical element to direct the steered laser beam; and

a workpiece support to which the steered laser beam is directed to work on a supported workpiece.

17. The system of Claim 16, wherein the acousto-optic deflector has a plurality of acoustic transducers on a surface of the acousto-optic deflector and wherein the transducers receive an acoustic frequency electric signal with a phase delay between the transducers to control the direction of the steered laser beam.

18. The system of Claim 17, wherein the plurality of acoustic transducers are arranged in two dimensions and wherein the electric input is configured to generate an acoustic frequency signal using the transducers with two sets of selected phase delays between the transducers, the first set of phase delays being in a first of the two dimensions of the transducers and the second set of phase delays being in a second of the two dimensions of the transducers to simultaneously control a deflection of the laser beam along the first and the second axis.

19. The system of Claim 17, wherein the acousto-optic deflector has a second plurality of acoustic transducers on a second surface of the acousto-optic deflector and wherein the second plurality of acoustic transducers receive a second acoustic frequency electric signal with a phase delay between the transducers to control the direction of the steered laser beam along a second axis.

20. The system of Claim 16, wherein electrical inputs to the transducers are adjusted to change acoustic frequencies across the transducers to achieve the Bragg condition for deflecting the laser beam under the Bragg condition.