Claims:

1. A method of radiatively scribing a substantially planar semiconductor substrate using a laser scribing apparatus, whereby a non-penetrative groove is formed along a scribeline that extends between opposing rows of semiconductor devices on a target surface of the substrate, whereby a Cartesian coordinate system XYZ can be defined in which:

- Said target surface lies in the XY plane;
- Said groove extends parallel to the Y direction, with a width in the X direction;

in which method:

- The substrate is clamped on a movable substrate holder so as to present said target surface to a laser scribing head;
- Relative motion is effected between said substrate holder and said scribing head, so as to cause laser radiation from the head to translate along a course of said scribeline,

characterized in that, when viewed in said XY plane, the laser scribing head produces a two-dimensional array of laser beam spots.

2. A method according to claim 1, wherein said two-dimensional array of laser beam spots comprises plural beam spots extending substantially parallel to both the Y and the X directions.

3. A method according to claim 1 or 2, wherein, in at least a first part of the array, when viewed parallel to the X direction, laser beams at the extremities of said array have a lower intensity than laser beams in a central portion of the array.

4. A method according to any of claims 1-3, wherein, in at least a second part of the array, when viewed parallel to the Y direction, at least one laser beam at an extremity of said array has an intensity that is lower than the average intensity of the laser beams in said second part.

5. A method according to any of claims 1-4, wherein said array is produced by using at least one Diffractive Optical Element to sub-divide a unitary laser beam.

6. A method according to claim 5, wherein said array is produced using a series arrangement of at least two Diffractive Optical Elements, one of which produces beam sub-division in the X direction and the other of which produces beam sub-division in the Y-direction.

7. A method according to any preceding claim, wherein not all laser beams in the array have the same focal depth relative to the XY plane.

8. A method according to any preceding claim, wherein the intensity of at least a subset of beams in said array is adjustable.

9. A method according to claim 8, wherein, before impinging upon the substrate, the array is caused to traverse a spatial light modulator device having a programmable surface comprising a matrix of pixels, individual pixels being adjustable so as to variably attenuate individual beams in the array.

10. A method according to claim 9, wherein said programmable surface comprises a liquid crystal screen.

11. A method according to any preceding claim, wherein concurrent use is made of a plurality of said two-dimensional arrays of laser beam spots to simultaneously scribe a given substrate along a corresponding plurality of scribelines.

12. An apparatus for radiatively scribing a substantially planar semiconductor substrate using laser radiation, whereby a non-penetrative groove is formed along a scribeline that extends between opposing rows of semiconductor devices on a target surface of the substrate, which apparatus comprises:

- A laser scribing head, for producing said laser radiation;
- A movable substrate holder, onto which the substrate can be clamped so as to present said target surface to the laser scribing head;

- Means for producing relative motion between said substrate holder and said scribing head, so as to cause laser radiation from the head to translate along a course of said scribeline,

characterized in that the laser scribing head is embodied to produce a two-dimensional array of laser beams.

CLAIMS

1. A method of radiatively scribing a substantially planar semiconductor substrate using a laser scribing apparatus, whereby a non-penetrative groove is formed along a scribeline that extends between opposing rows of semiconductor devices on a target surface of the substrate, whereby a Cartesian coordinate system XYZ can be defined in which: Said target surface lies in the XY plane; Said groove extends parallel to the Y direction, with a width in the X direction; the method comprising: clamping the substrate on a movable substrate holder of the laser scribing apparatus such that the target surface is positioned to be targeted by a laser scribing head of the laser scribing apparatus; relatively moving said substrate holder and said scribing head, so as to cause laser radiation from the head to translate along a course of said scribeline, such that, when viewed in said XY plane, the laser scribing head produces a two-dimensional array of laser beam spots to form the groove.

2. A method according to claim 1, wherein said two-dimensional array of laser beam spots comprises plural beam spots extending substantially parallel to both the Y and the X directions.

3. A method according to claim 1 or claim 2, wherein, in at least a first part of the array, when viewed parallel to the X direction, laser beams at the extremities of said array have a lower intensity than laser beams in a central portion of the array.

4. A method according to any one of the preceding claims, wherein, in at least a second part of the array, when viewed parallel to the Y direction, at least one laser beam at an extremity of said array has an intensity that is lower than the average intensity of the laser beams in said second part.

5. A method according to any one of the preceding claims, wherein said array is produced by using at least one diffractive optical element to sub-divide a unitary laser beam.

6. A method according to claim 5, wherein said array is produced using a series arrangement of at least two diffractive optical elements, one of which produces beam sub-division in the X direction and the other of which produces beam sub-division in the Y-direction.

7. A method according to any one of the preceding claims, wherein not all laser beams in the array have the same focal depth relative to the XY plane.

8. A method according to any one of the preceding claims, wherein the intensity of at least a subset of beams in said array is adjustable.

9. A method according to claim 8, wherein, before impinging upon the substrate, the array is caused to traverse a spatial light modulator device having a programmable surface comprising a matrix of pixels, individual pixels being adjustable so as to variably attenuate individual beams in the array.

10. A method according to claim 9, wherein said programmable surface comprises a liquid crystal screen.

11. A method according to any one of the preceding claims, wherein concurrent use is made of a plurality of said two-dimensional arrays of laser beam spots to simultaneously scribe a given substrate along a corresponding plurality of scribelines.

12. An apparatus for radiatively scribing a substantially planar semiconductor substrate using laser radiation, whereby a non-penetrative groove is formed along a scribeline that extends between opposing rows of semiconductor devices

on a target surface of the substrate, which apparatus comprises: a laser scribing head, for producing said laser radiation; a movable substrate holder, configured and arranged to clamp the substrate thereto so as to present said target surface to the laser scribing head; an actuator, constructed and arranged to produce relative motion between said substrate holder and said scribing head, so as to cause laser radiation from the head to translate along a course of said scribeline, wherein the laser scribing head is constructed and arranged to produce a two-dimensional array of scribing laser beams to form the groove.

13. An apparatus as in claim 12, further comprising at least one diffractive optical element, constructed and arranged to sub-divide a unitary laser beam to form the two-dimensional array of scribing laser beams.

14. An apparatus as in claim 13, wherein the at least one diffractive optical element comprises a series arrangement of at least two diffractive optical elements, one of which is constructed and arranged to produce beam sub-division in the X-direction and the other of which is constructed and arranged to produce beam sub-division in the Y-direction.

15. An apparatus as in any one of claims 12 to 14, wherein the laser scribing head is constructed and arranged to produce the two-dimensional array of scribing laser beams such that not all laser beams in the array have the same focal depth relative to the XY plane.

16. An apparatus as in any one of claims 12 to 15, further comprising a spatial light modulator having a programmable surface comprising a matrix of pixels, individual pixels being adjustable so as to variably attenuate individual beams of the array of scribing laser beams.

17. An apparatus as in claim 16, wherein the programmable surface comprises a liquid crystal screen.