CLAIMS

1. Illuminating apparatus for illuminating a sample (66) on a work stage (68) with a sharp illuminating line (70) of controlled energy, said illuminating line (70) being generated from a laser beam (12) propagating along a beam path (13) and being emitted from a laser source (10) and having a dimension in a first direction (x) exceeding a dimension in a second direction (y) being perpendicular to said first direction (x),
comprising:
- a beam shaping optical system (80) for shaping said laser beam (12) into a line shape (70a),
- an energy measuring device (58) for measuring energy of said laser beam (12),
- an energy control system (76) for generating a control signal (78) upon said measured laser beam energy and for controlling energy output of said laser source (10) and /or transmission of one or more components of said beam shaping optical system (80) upon said control signal (78),
characterized in that
- said energy measuring device (58) is arranged in said beam path (13) after said beam shaping optical system (80) and before said work stage (68).

2. Illuminating apparatus according to claim 1, characterized in that said control signal (78) being indicative of an averaged beam energy along the dimension of said line shaped beam (70a) in said first direction (x).

3. Illuminating apparatus according to one of the preceding claims, characterized in that said energy measuring device (58) comprises a beam splitter (84) for coupling out a fraction (70b) of said line shaped beam (70a) and a detector (86) for detecting said fraction (70b).

4. Illuminating apparatus according to claim 3, characterized in that said detector (86) comprises a plurality of photodiodes (90a, 90b, 90c, 90d) being arranged side by side in said first direction (x) for collecting said fraction (70b).

5. Illuminating apparatus according to claim 4, characterized in that said detector (86) further comprises a plurality of lenses (88a, 88b, 88c, 88d) for focusing said fraction (70b) onto said plurality of photodiodes (90a, 90b, 90c, 90d).

6. Illuminating apparatus according to one of the preceding claims, characterized in that further comprises a reducing optics (82) for reducing said line shaped beam (70a) in said second direction (y).

7. Illuminating apparatus according to one of the preceding claims, characterized in that further comprises an imaging optics (82) for imaging said line shaped beam (70a) onto said sample (66).

8. Illuminating apparatus according to one of the preceding claims, characterized in that said beam shaping optical system (80) comprises a homogenizer (40) for homogenizing said laser beam (12) at least along its dimension in said first direction (x).

9. Illuminating apparatus according to one of the preceding claims, characterized in that said beam shaping optical system (80) comprises a field defining optical device (54) for defining the dimension of said laser beam (12) at least in said second direction (y).

10. Method for controlling energy of a laser source (10) when illuminating a sample (66) on a work stage (68) with a narrow illuminating line (70), whereby said illuminating line (70) being generated from a laser beam (12) propagating along a beam path (13) and being emitted from said laser source (10) and having an dimension in a first direction (x) exceeding an dimension in a second direction (y) being perpendicular to said first direction by a multiple, comprising the steps of:

- shaping said laser beam into a line shape (70a) with a beam shaping optical system (80),
- measuring energy of said laser beam (12),
- generating a control signal (78) upon said measured laser beam energy, and
- controlling energy output of said laser source (10) and / or transmission of one or more components of said beam shaping optical system (80) upon said control signal (78),

characterized in

- measuring said energy of said laser beam (12) in said beam path (13) after said beam shaping and before said work stage (68).

11. Method according to claim 10, characterized in that said control signal (78) being indicative of an averaged beam energy along the dimension of said line shaped beam (70a) in said first direction (x).

12. Method according to one of the claims 10 or 11, characterized in splitting said laser beam (12) in said beam path (13) after shaping said beam and before said work stage (68) and out coupling a fraction (70b) by splitting and detecting said fraction (70b).

13. Method according to claim 12, characterized by averaging a beam energy of said fraction (70b) along the dimension of said fraction (70b) in said first direction (x).

14. Method according to claim 13, characterized in dividing said fraction (70b) into a plurality of sub beams (92a, 92b, 92c, 92d) and focusing said plurality of sub beams (92a, 92b, 92c, 92d) onto a plurality of photodiodes (90a, 90b, 90c, 90d).

15. Method according to one of claims 10 to 14, characterized in further reducing said line shaped beam (70a) in said second direction (y).

16. Method according to one of claims 10 to 15, characterized in further imaging said line shaped beam (70a) onto said sample (66).

17. Method according to one of claims 10 to 16, characterized in that said beam shaping comprises homogenizing said laser beam (12) at least along its dimension in said first direction (x).

18. Method according to one of claims 10 to 16, characterized in that said beam shaping comprises defining the dimension of said laser beam (12) at least in said second direction (y).

19. Illuminating apparatus for illuminating a sample (66) on a work stage (68) with a narrow illuminating line 870) of controlled energy, said illuminating line (70) being generated from a laser beam (12) propagating along a beam path (13) and being emitted from a laser source (10) and having an dimension in a first direction (x) exceeding an dimension in a second direction (y) being perpendicular to said first direction (x) by a multiple, comprising:

- a beam shaping optical system (80) for shaping said laser beam (12) into a line shape (70a),
- an energy measuring device (58) for measuring energy of said laser beam (12),
- an energy control system (76) for generating a control signal (78) upon said measured laser beam energy and for controlling energy output of said laser source (10) upon said control signal (78),

characterized in that

- said control signal (78) being indicative of an averaged beam energy along the dimension of said line shaped beam (70a) in said first direction (x).

20. Illuminating apparatus according to claim 19, characterized in that said energy measuring device (58) comprises a beam splitter (84) for coupling out a fraction (70b) of said line shaped beam (70a) and a detector (86) for detecting said fraction (70b).

21. Illuminating apparatus according to claim 20, characterized in that said detector (86) comprising a plurality of photodiodes (90a, 90b, 90c, 90d) being arranged side by side in said first direction (x) for collecting said fraction (70b).

22. Illuminating apparatus according to claim 21, characterized in that said detector (86) further comprises a plurality of spherical lenses (88a, 88b, 88c, 88d) for focusing said fraction (70b) onto said plurality of photodiodes (90a, 90b, 90c, 90d).

23. Illuminating apparatus according to claim 22, characterized in that said at least two of said photodiodes (90a, 90b, 90c, 90d) being electrically coupled in parallel.

24. Illuminating apparatus according to one of claims 22 or 23, characterized in that at least one of said photodiodes (90a, 90b, 90c, 90d) being electrically coupled in series to a shunt resistor (R_s).

25. Illuminating apparatus according to one of claims 22 to 24, characterized in that at least one of said photodiodes (90a, 90b, 90c, 90d) being electrically reverse-biased (V_0).

26. Method for controlling energy of a laser source (10) when illuminating a sample (66) on a work stage (68) with a narrow illuminating line (70), whereby said illuminating line (70) being generated from a laser beam (12) propagating along a beam path (13) and being emitted from said laser source (10) and having an dimension in a first direction (x) exceeding an dimension in a second direction (y) being perpendicular to said first direction (x) by a multiple, comprising the steps of:
- shaping said laser beam (12) into a line (70a),
- measuring energy of said line shaped laser beam (12),
- generating a control signal (78) upon said measured laser beam energy,
- controlling energy output of said laser source (10) upon said control signal (78),
characterized in that
- said control signal (78) being indicative of an averaged beam energy along the dimension of said line shaped beam (70a) in said first direction.

27. Method according to claim 26, characterized in coupling out a fraction (70b) of said line shaped beam (70a) and detecting said fraction.

28. Method according to claim 27, characterized in dividing said fraction (70b) into a plurality of beamlets (92a, 92b, 92c, 92d) and detecting each of said beamlets (92a, 92b, 92c, 92d) separately.

29. Method according to claim 28, characterized in focusing each of said plurality of beam lets (92a, 92b, 92c, 92d) separately.

30. Method according to one of claim 28 or 29, characterized in converting detection signals (I_{pha}, I_{phb}, I_{phc}, I_{phd}) being generated upon detecting each of said beamlets (92a, 92b, 92c, 92d) separately into a sum signal (74).

31. Method according to claim 30, characterized in converting said sum signal (74) into said control signal (78, V_{out}).

CLAIMS

1. An illuminating apparatus configured to illuminate a sample when the sample is in a work stage, the illuminating apparatus comprising:

a beam shaping optical system configured to shape a laser beam into a line-shaped laser beam having a dimension in a first direction that exceeds a dimension in a second direction perpendicular to the first direction, the laser beam being emitted during use by a laser source and propagating through the illuminating apparatus along a beam path, the beam shaping unit comprising a homogenizer configured to homogenize the laser beam at least along the first direction;

an energy measuring device configured to measure an energy of the line-shaped laser beam; and

an energy control system configured to generate a control signal based on the measured energy of the laser beam, the energy control system being configured to control energy output of the laser source and/or transmission of one or more components of the beam shaping optical system based on the control signal,

wherein the energy measuring device is in the beam path between the homogenizer of the beam shaping optical system and the work stage.

2. The illuminating apparatus according to claim 1, wherein the control signal is indicative of an average beam energy of the line-shaped laser beam along the first direction.

3. The illuminating apparatus according to claim 1, wherein the energy measuring device comprises:

a beam splitter configured to couple out a fraction of the line-shaped laser beam to provide a coupled out fraction; and

a detector configured to detect the coupled out fraction.

4. The illuminating apparatus according to claim 3, wherein the detector comprises a plurality of photodiodes arranged side by side in the first direction, the plurality of photodiodes being configured to collect the coupled out fraction.

5. The illuminating apparatus according to claim 4, wherein the detector further comprises a plurality of lenses configured to focus the coupled out fraction onto the plurality of photodiodes.

6. The illuminating apparatus according to claim 1, further comprising reducing optics configured to reduce a size of the line-shaped laser beam in the second direction.

7. The illuminating apparatus according to claim 1, further comprising imaging optics configured to image the line-shaped laser beam onto the sample.

8. The illuminating apparatus according to claim 1, wherein the beam shaping optical system comprises a field defining optical device configured to define the dimension of the laser beam in at least in the second direction.

9. The illuminating apparatus according to claim 1 wherein the laser beam represents a XeCl laser beam.

10. The illuminating apparatus according to claim 1 wherein a ratio of said dimension in said first direction to said dimension in said second direction is at least $2.5x10^4$.

11. The illuminating apparatus according to claim 1 wherein the laser beam is a pulsed laser beam with a repetition rate between 100 Hz to 10 kHz.

12. The illuminating apparatus according to claim 5 wherein at least one of said plurality of lenses represents a spherical lens.

13. A method of illuminating a sample when the sample is in a work stage, the method comprising:

shaping a laser beam into a line-shaped laser beam with a beam shaping optical system which comprises a homogenizer configured to homogenize the laser beam at least along the first direction;

measuring an energy of the line-shaped laser beam;

generating a control signal based on the measured energy of the line-shaped laser beam; and

controlling an energy output of the laser source and/or transmission of one or more components of the beam shaping optical system based on the control signal,

wherein the energy of the line-shaped laser beam is measured at a location of a path of the line-shaped laser beam that is between the homogenizer of the beam shaping optical system and the work stage.

14. The method according to claim 13, wherein the control signal is indicative of an averaged beam energy of the line-shaped laser beam along the first direction.

15. The method according to claim 13, further comprising:

splitting the line-shaped laser beam to provide a coupled out fraction; and

detecting the coupled out fraction.

16. The method according to claim 15, further comprising averaging an energy of the coupled out fraction along the first direction.

17. The method according to claim 16, further comprising:

dividing the coupled out fraction into a plurality of beamlets; and

focusing the plurality of beamlets onto a plurality of photodiodes.

18. The method according to claim 13, further comprising reducing the line-shaped laser beam in the second direction.

19. The method according to claim 13, further comprising imaging the line-shaped laser beam onto the sample.

20. The method according to claim 13, beam shaping comprises defining a dimension of the line-shaped laser beam at least in the second direction.