

WHAT IS CLAIMED IS:

1 1. A system for performing cytometry, the system comprising:
2 a light source;
3 a light shaping element that concentrates light from the light source onto an
4 oblong field at a scanning region;
5 a linear light sensor; and
6 an optical system that focuses an image of a portion of the scanning region
7 onto a linear light sensor;
8 wherein the system repeatedly takes readings of light falling on the linear
9 sensor while a cell is transported through the scanning region and illuminated by the light
10 source.

1 2. The system of claim 1, further comprising a slit aperture proximate the
2 linear sensor, such that the system performs semi-confocal imaging.

1 3. A system for performing cytometry, the system comprising:
2 a light source that illuminates a scanning region;
3 at least two parallel linear light sensors; and
4 an optical system that focuses an image of a portion of the scanning region
5 onto the at least two parallel linear light sensors;
6 wherein the system repeatedly takes readings of light falling on the linear
7 sensors while a cell is transported through the scanning region and illuminated by the light
8 source.

1 4. The system of claim 3, further comprising a slit aperture proximate the
2 linear sensors, such that the system performs semi-confocal imaging.

1 5. The system of claim 3, wherein images gathered by the individual
2 linear light sensors are combined to form an image with improved signal-to-noise
3 characteristics as compared with an image gathered by a single linear light sensor.

1 6. The system of claim 5, wherein the images are combined by digitally
2 combining pixel values from the respective images corresponding to substantially the same
3 respective locations on the cell.

1 7. The system of claim 5, wherein the images are combined by time delay
2 integration.

1 8. The system of claim 3, further comprising a light shaping element that
2 concentrates light from the light source onto an oblong field at the scanning region.

1 9. A system for performing cytometry, the system comprising:
2 a scanning region that is illuminated by light including at least first and second
3 wavelength bands;

4 means for transporting a cell through the scanning region such that the cell is
5 illuminated;

6 first and second sets of linear light sensors, each set comprising at least one
7 linear light sensor; and

8 an optical system that selectively directs light emitted from the cell to the two
9 linear light sensor sets such that emitted light in a third wavelength band is primarily directed
10 to the first linear light sensor set, and emitted light in a fourth wavelength band is primarily
11 directed to the second linear light sensor set;

12 wherein the system repeatedly takes readings of light falling on the linear
13 sensors while the cell is transported through the scanning region.

1 10. The system of claim 9, wherein each linear light sensor set comprises
2 at least two linear light sensors.

1 11. The system of claim 9, wherein the emitted light is emitted as a result
2 of fluorescence.

1 12. The system of claim 9, wherein the optical system further comprises:
2 an objective lens that receives and redirects light emitted from the cell;
3 a mirror that reflects a first portion of the redirected light to the first linear
4 light sensor set and transmits a second portion of the redirected light.

1 13. The system of claim 12, further comprising:

2 a first tube lens that receives the first portion of light and cooperates with the
3 objective lens to form an image of the cell on the first linear light sensor set.

1 14. The system of claim 13, further comprising a second tube lens that
2 receives the second portion of light and cooperates with the objective lens to form an image
3 of the cell on the second set of linear light sensors.

1 15. The system of claim 9, further comprising a slit aperture proximate at
2 least one of the sets of linear light sensors, such that the system performs semi-confocal
3 imaging.

1 16. The system of claim 9, wherein each set of linear light sensors
2 comprises at least two linear light sensors, and wherein for each set of linear light sensors,
3 images gathered by the individual linear light sensors in the set are combined to form an
4 image with improved signal-to-noise characteristics as compared with an image gathered by a
5 single linear light sensor in the set.

1 17. The system of claim 16, wherein the images are combined by digitally
2 combining pixel values from the respective images corresponding to substantially the same
3 respective locations on the cell.

1 18. The system of claim 16, wherein the images are combined by time
2 delay integration.

1 19. A system for performing cytometry, the system comprising:
2 a scanning region that is illuminated by light including at least first and second
3 wavelength bands;
4 means for transporting a cell through the scanning region such that the cell is
5 illuminated;
6 a set comprising at least one linear light sensor; and
7 an optical system that selectively directs light emitted from the cell to two
8 portions of the linear light sensor set such that emitted light in a third wavelength band is
9 primarily directed to a first portion of the linear light sensor set, and emitted light in a fourth
10 wavelength band is primarily directed to a second portion of the linear light sensor set;
11 wherein the system repeatedly takes readings of light falling on the linear light
12 sensor set while the cell is transported through the scanning region.

1 20. The system of claim 19, wherein the set comprises at least two linear
2 light sensors.

1 21. The system of claim 19, wherein the emitted light is emitted as a result
2 of fluorescence.

1 22. The system of claim 19, further comprising a slit aperture proximate
2 the linear light sensor set, such that the system performs semi-confocal imaging.

1 23. The system of claim 19, wherein the set comprises at least two linear
2 light sensors, and wherein images gathered by the individual linear light sensors in the set are
3 combined to form an image with improved signal-to-noise characteristics as compared with
4 an image gathered by a single linear light sensor in the set.

1 24. The system of claim 23, wherein the images are combined by digitally
2 combining pixel values from the respective images corresponding to substantially the same
3 respective locations on the cell.

1 25. The system of claim 23, wherein the images are combined by time
2 delay integration.

1 26. A system for performing cytometry, the system comprising:
2 a scanning region that is illuminated by a light source;
3 a set comprising at least one linear light sensor; and
4 an optical system that focuses an image of a portion of the scanning region
5 onto the linear light sensor set;
6 wherein the system repeatedly takes readings of light falling on the linear light
7 sensor set while a cell is transported through the scanning region and illuminated by the light
8 source;
9 and wherein the system is configurable such that during a first experiment, a
10 first image is created having a first number of pixels in a dimension corresponding to the
11 length of the linear light sensor set, and during a second experiment, a second image is
12 created having a second number of pixels in the dimension corresponding the length of the
13 linear light sensor set, the second number of pixels being fewer than the first.

1 27. The system of claim 26, wherein the set comprises at least two linear
2 light sensors.

1 28. The system of claim 26, wherein the number of pixels in the second
2 image is reduced by selecting fewer than all of the pixels from the linear light sensor set.

1 29. The system of claim 26, wherein the number of pixels the second
2 image is reduced by binning some or all of the pixels from the linear light sensor set.

1 30. The system of claim 26, wherein each reading of light falling on a
2 particular linear sensor results in a single numerical representation of the amount of light
3 falling on the particular sensor.

1 31. A system for producing an oblong illumination field, the system
2 comprising:
3 a laser that produces a beam;
4 a cylindrical lens that receives the beam and causes the beam to converge in
5 only a first axis;
6 an objective lens that is part of an infinity-corrected optical system, the
7 objective lens receiving the beam after the cylindrical lens and converging the beam in a
8 second axis orthogonal to the first.

1 32. The system of claim 31, further comprising a wavelength-selective
2 mirror between the cylindrical lens and the objective lens.

1 33. The system of claim 31, wherein the objective lens is spaced from the
2 cylindrical lens by a distance less than the focal length of the cylindrical lens.

1 34. The system of claim 31, wherein the objective lens is spaced from the
2 cylindrical lens by a distance greater than the focal length of the cylindrical lens.

1 35. The system of claim 31, wherein the beam is diverging in the first axis
2 as it leaves the objective lens.

1 36. The system of claim 31, wherein the beam is converging in the first
2 axis as it leaves the objective lens.

1 37. A method of performing cytometry, the method comprising:
2 illuminating, using a light source, an oblong field at a scanning region,
3 wherein illuminating the oblong field further includes concentrating, using a light shaping
4 element, light from the light source onto the oblong field;

5 focusing, using an optical system, an image of a portion of the scanning region
6 onto a linear light sensor; and
7 repeatedly taking readings of light falling on the linear sensor while a cell is
8 transported through the scanning region and illuminated by the light source.

1 38. The method of claim 37, further comprising passing the light falling on
2 the linear light sensor through a slit aperture proximate the linear light sensor, such that the
3 system performs semi-confocal imaging.

1 39. A method of performing cytometry, the method comprising:
2 illuminating, using a light source, a scanning region;
3 focusing, using an optical system, an image of a portion of the scanning region
4 onto at least two parallel linear light sensors;
5 repeatedly taking readings of light falling on the two parallel light sensors
6 while a cell is transported through the scanning region and illuminated by the light source.

1 40. The method of claim 39, further comprising combining images
2 gathered by the individual linear light sensors to form an image with improved signal-to-
3 noise characteristics as compared with an image gathered by a single linear light sensor.

1 41. The method of claim 40, wherein combining images further comprises
2 digitally combining pixel values from the respective images corresponding to substantially
3 the same respective locations on the cell.

1 42. The method of claim 40, wherein combining images further comprises
2 combining images using time delay integration.

1 43. The method of claim 39, wherein the light source produces
2 illumination including light in at least first and second wavelength bands, and wherein the
3 method further comprises:
4 directing, using the optical system, light emitted from the cell in a third
5 wavelength band primarily to one of the two parallel light sensors, and directing, using the
6 optical system, light emitted from the cell in a fourth wavelength band primarily to the other
7 of the two parallel linear light sensors.

1 44. The method of claim 39, further comprising focusing, using the optical
2 system, an image of a portion of the scanning region onto at least two sets of parallel linear
3 light sensors, each set comprising at least two linear light sensors.

What is claimed is:

1. A system for performing cytometry, the system comprising:

a light source that illuminates a scanning region;
at least two parallel linear light sensors; and
an optical system that focuses an image of a portion of the scanning region onto the at least two parallel linear light sensors;

wherein the system repeatedly takes readings of light falling on the linear sensors while a cell is transported through the scanning region and illuminated by the light source.

2. The system of claim 1, further comprising a slit aperture proximate the linear sensors, such that the system performs semi-confocal imaging.

3. The system of claim 1, wherein images gathered by the individual linear light sensors are combined to form an image with improved signal-to-noise characteristics as compared with an image gathered by a single linear light sensor.

4. The system of claim 3, wherein the images are combined by digitally combining pixel values from the respective images corresponding to substantially the same respective locations on the cell.

5. The system of claim 3, wherein the images are combined by time delay integration.

6. The system of claim 1, further comprising a light shaping element that concentrates light from the light source onto an oblong field at the scanning region.

7. A system for performing cytometry, the system comprising:

a scanning region that is illuminated by light including at least first and second wavelength bands;
means for transporting a cell through the scanning region

such that the cell is illuminated;
first and second sets of linear light sensors, each set comprising at least one linear light sensor; and
an optical system that selectively directs light emitted from the cell to the two linear light sensor sets such that emitted light in a third wavelength band is primarily directed to the first linear light sensor set, and emitted light in a fourth wavelength band is primarily directed to the second linear light sensor set;
wherein the system repeatedly takes readings of light falling on the linear sensors while the cell is transported through the scanning region.

8. The system of claim 7, wherein each linear light sensor set comprises at least two linear light sensors.

9. The system of claim 7, wherein the emitted light is emitted as a result of fluorescence.

10. The system of claim 7, wherein the optical system further comprises:

an objective lens that receives and redirects light emitted from the cell;

a mirror that reflects a first portion of the redirected light to the first linear light sensor set and transmits a second portion of the redirected light.

11. The system of claim 10, further comprising:

a first tube lens that receives the first portion of light and cooperates with the objective lens to form an image of the cell on the first linear light sensor set.

12. The system of claim 11, further comprising a second tube lens that receives the second portion of light and cooperates with the objective lens to form an image of the cell on the second set of linear light sensors.

13. The system of claim 7, further comprising a slit aperture proximate at least one of the sets of linear light sensors, such that the system performs semi-confocal imaging.

14. The system of claim 7, wherein each set of linear light sensors comprises at least two linear light sensors, and wherein for each set of linear light sensors, images gathered by the individual linear light sensors in the set are combined to form an image with improved signal-to-noise characteristics as compared with an image gathered by a single linear light sensor in the set.

15. The system of claim 14, wherein the images are combined by digitally combining pixel values from the respective images corresponding to substantially the same respective locations on the cell.

16. The system of claim 14, wherein the images are combined by time delay integration.

17. A system for performing cytometry, the system comprising:

- a scanning region that is illuminated by a light source;
- a set comprising at least two linear light sensors; and
- an optical system that focuses an image of a portion of the scanning region onto the linear light sensor set;

wherein the system repeatedly takes readings of light falling on the linear light sensor set while a cell is transported through the scanning region and illuminated by the light source;

and wherein the system is configurable such that during a first experiment, a first image is created having a first number of pixels in a dimension corresponding to the length of the linear light sensor set, and during a second experiment, a second image is created having a second number of pixels in the dimension corresponding the length of the linear light sensor set, the second number of pixels being fewer than the first.

18. The system of claim 17, wherein the system is configured such that the number of pixels in the second image is reduced by selecting fewer than all of the pixels from the linear light sensor set.

19. The system of claim 17, wherein the system is configured such that the number of pixels the second image is reduced by binning some or all of the pixels from the linear light sensor set.

20. The system of claim 17, wherein the system is configured such that each reading of light falling on a particular linear sensor results in a single numerical representation of the amount of light falling on the particular sensor.

21. A method of performing cytometry, the method comprising:

illuminating, using a light source, a scanning region;

focusing, using an optical system, an image of a portion of the scanning region onto at least two parallel linear light sensors;

repeatedly taking readings of light falling on the two parallel light sensors while a cell is transported through the scanning region and illuminated by the light source.

22. The method of claim 21, further comprising combining images gathered by the individual linear light sensors to form an image with improved signal-to-noise characteristics as compared with an image gathered by a single linear light sensor.

23. The method of claim 22, wherein combining images further comprises digitally combining pixel values from the respective images corresponding to substantially the same respective locations on the cell.

24. The method of claim 22, wherein combining images further comprises combining images using time delay integration.

25. The method of claim **21**, wherein the light source produces illumination including light in at least first and second wavelength bands, and wherein the method further comprises:

directing, using the optical system, light emitted from the cell in a third wavelength band primarily to one of the two parallel light sensors, and directing, using the optical system, light emitted from the cell in a fourth wavelength band primarily to the other of the two parallel linear light sensors.

26. The method of claim **21**, further comprising focusing, using the optical system, an image of a portion of the scanning region onto at least two sets of parallel linear light sensors, each set comprising at least two linear light sensors.