## What Is Claimed:

1. A system for analyzing biological material comprising:

a light source configured to emit excitation light onto a biological material sample, the excitation light having a wavelength that causes a fluorophore in proximity to or within the biological material to undergo a fluorescent emission or phosphorescent emission;

an optical communication path positioned to obtain an optical signal indicative of the fluorescent emission or phosphorescent emission associated with the fluorophore;

a time-of-flight sensor comprising a plurality of pixels configured to receive the signal indicative of the fluorescent emission or phosphorescent emission from the optical communication path, each pixel of the plurality of pixels configured to provide a signal associated with a photo-response of the pixel based at least in part on the optical signal; and

one or more processors in communication with the time-of-flight sensor, the one or more processors configured to determine a fluorescent lifetime or a fluorescent intensity of the fluorophore based at least in part on the photo-response of each pixel.

2. A system as defined in claim 1, further comprising a sample staging site for holding a sample of a biological material.

3. A system as defined in claim 1, wherein the light source and time-of-flight sensor are part of a Light Detection and Ranging (LiDAR) subsystem.

4. A system as defined in claim 1 or 2, wherein the system includes a plurality of samples, each sample being associated with an optical communication path, wherein the pixels of the time-of-flight sensor are divided into a plurality of zones, each optical communication path associated with each sample being in communication with at least one of the plurality of zones, and wherein the time-of-flight sensor and the one or more processors are configured to receive fluorescent emissions or phosphorescent emissions from each sample and determine the fluorescent lifetime or the fluorescent intensity of a fluorophore from each sample.

5. A system as defined in claim 4, further comprising a plurality of staging sites for holding the plurality of samples.

6. A system as defined in claim 5, wherein the system includes at least 25 sample staging sites, such as at least 50 sample staging sites, such as at least 75 sample staging sites, such as at least 96 staging sites, such as at least 384 staging sites, such as at least 1536 staging sites.

7. A system as defined in claim 5, wherein the system includes less than 25 sample staging sites.

8. A system as defined in any of the preceding claims, further comprising a fluorophore source for placing at least one fluorophore in association with the biological material.

9. A system as defined in any of the preceding claims, wherein the light source comprises a laser, a laser diode or a light emitting diode (LED).

10. A system as defined in any of the preceding claims, wherein the light source is configured to emit the excitation light at a modulation rate.

11. The system as defined in claim 10, wherein the modulation rate is selected based at least in part on the fluorescent lifetime of the fluorescent emission or phosphorescent emission associated with the fluorophore.

12. The system as defined in claim 11, wherein the modulation rate is a range of about 0.01 MHz to about 1000 MHz.

13. The system as defined in claim 12, wherein a decay time isin a range of about 0.1 nanoseconds to about 20 nanoseconds.

14. A system as defined in any of the preceding claims, wherein the signal indicative of the photo-response comprises a signal indicative of a response phase for the pixel.

15. The system as in claim 14, wherein the response phase for a pixel is determined based at least in part by performing operations, the operations comprising:

determining a first response for the pixel from a first analog integrator;

determining a second response for the pixel using a second analog integrator;

determining the response phase based at least in part on the first response and the second response.

16. The system of claim 15, wherein one or more processors are configured to determine the fluorescent lifetime based at least in part on the response phase.

17. A system as defined in any of the preceding claims, wherein the light source is configured to emit an incoherent light beam.

18. A system as defined in any of the preceding claims, wherein the system further includes a tray that defines a plurality of sample staging sites, the system further comprising an array of plungers that move relative to the tray, the plungers being spaced apart so as to align with the sample staging sites on the tray, the plungers being configured to move towards the sample staging sites for contacting the biological material located in the sample staging sites, the plungers being in communication with the optical communication path for delivering the excitation light to the biological material and for delivering the fluorescent emission or phosphorescent emission produced by the fluorophore to the time-of-flight sensor.

19. A system as defined in any of the preceding claims, wherein the light source and the time-of-flight sensor operate at a frequency that permits multiple determinations of the fluorescent lifetime or the fluorescent intensity of the fluorophore in less than about 1 second, such as less than about 0.5 seconds.

20. A system as defined in claim 8, wherein the fluorophore source is configured to place a plurality of fluorophores in association with the biological material, and wherein the time-of-flight sensor and one or more processors are configured to determine the fluorescent lifetime or the fluorescent intensity of the plurality of fluorophores.

21. A system as defined in claim 1, wherein the optical communication path does not contain any optical fibers.

22. A system as defined in claim 1, wherein the optical communication path includes imaging optics.

23. A system as defined in claim 1, wherein the optical communication path includes light gathering optics.

24. A system as defined in any of the preceding claims, wherein the time-of-flight sensor and one or more processors are configured to determine the

fluorescent lifetime without calibrating the light source between testing of consecutive samples of the biological material.

25. A system as defined in any of the preceding claims, wherein the fluorescent emission or phosphorescent emission of the fluorophore is indicative of a parameter related to cellular metabolism, such as a dissolved gas, an ion, a protein, a metabolite, a nucleic acid, an enzyme, pH, an oxidation state, a viscosity, temperature, NAD(P)H, a salt, or a mineral.

26. A system as defined in claim 25, wherein the parameter comprises pH and wherein the flurophore exhibits a fluorescent lifetime of less than 5 nanoseconds.

27. A system as defined in claim 25, wherein the system is further configured to determine a concentration of the parameter or a rate of change of the parameter.

28. A system as defined in claim 2, wherein the sample staging site is part of a microfluidic device.

29. A system for analyzing biological material comprising:

a Light Detection and Ranging (LIDAR) subsystem, the Light Detection and Ranging (LIDAR) subsystem comprising:

(a) a light source configured to emit excitation light onto a biological material, the excitation light having a wavelength that causes a fluorophore associated with the biological material to undergo a fluorescent emission or phosphorescent emission;

(b) an optical communication path positioned to sense the fluorescent emission or phosphorescent emission produced by the fluorophore; and

(c) a time-of-flight sensor comprising a plurality of pixels configured to receive the fluorescent emission or phosphorescent emission from the optical communication path; and

one or more processors in communication with the time-of-flight sensor for determining a fluorescent lifetime or a fluorescent intensity of the fluorophore based on the fluorescent emission or phosphorescent emission of the fluorophore.

30. A system as defined in claim 29, wherein the one or more processors are further configured to determine a magnitude characteristic of a biological parameter based on the fluorescent lifetime or the fluorescent intensity.

~~31. A system as defined in claim 29 or 30, wherein the system includes a plurality of sample staging sites, each sample staging site being associated with an optical communication path and wherein the pixels of the time-of-flight sensor are divided into zones, each optical communication path associated with each sample staging site being in communication with a corresponding zone and wherein the time-of-flight sensor and the one or more processors are configured to simultaneously receive fluorescent emissions or phosphorescent emissions from each sample staging site and determine the fluorescent lifetime or the fluorescent intensity of the fluorophore from each sample staging site.~~

~~32. A system as defined in claim 31, wherein the system includes at least 25 sample staging sites, such as at least 50 sample staging sites, such as at least 75 sample staging sites, such as at least 96 staging sites, such as at least 384 staging sites, such as at least 1536 staging sites.~~

~~33. A system as defined in any of claims 29 through 32, wherein the one or more processors are configured to determine the fluorescent lifetime of the fluorophore and wherein the time-of-flight sensor and one or more processors are configured to determine the fluorescent lifetimes of fluorophores without calibrating the light source between testing of consecutive samples of the biological material.~~

~~34. A system as defined in any of claims 29 through 33, further comprising a fluorophore source for placing at least one fluorophore in association with the biological material.~~

~~35. A system as defined in claim 34, wherein the light source is configured to emit the excitation light at a modulation rate.~~

~~36. The system as defined in claim 35, wherein the modulation rate is determined based at least in part on a decay time of the fluorescent emission or phosphorescent emission associated with the fluorophore.~~

~~37. The system as defined in claim 36, wherein the modulation rate is a range of about 0.01 MHz to about 1000 MHz.~~

~~38. The system as defined in claim 37, wherein a decay time isin a range of about 0.1 nanoseconds to about 20 nanoseconds.~~

~~39. A system as defined in any of claims 29 through 38, wherein the signal indicative of the photo-response comprises a signal indicative of a response phase for the pixel.~~

40. The system as in claim 39, wherein the response phase for a pixel is determined based at least in part by performing operations, the operations comprising:

determining a first response for the pixel from a first analog integrator;

determining a second response for the pixel using a second analog integrator;

determining the response phase based at least in part on the first response and the second response.

41. The system of claim 40, wherein one or more processors are configured to determine the fluorescent lifetime based at least in part on the response phase.

42. A system as defined in claim 29 or 30, wherein each pixel in the time-of-flight sensor is configured to receive fluorescent emissions or phosphorescent emissions from the optical communication path in phase with the light source.

43. A system as defined in any of claims 29 through 42, wherein the system further includes a tray that defines a plurality of sample staging sites, the system further comprising an array of plungers that move relative to the tray, the plungers being spaced apart so as to align with the sample staging sites on the tray, the plungers being configured to move towards the sample staging sites for contacting the biological material located in the sample staging sites, the plungers being in communication with the optical communication path for delivering the excitation light to the biological material and for delivering the fluorescent emission or phosphorescent emission produced by a fluorophore associated with the biological material to the time-of-flight sensor.

44. A system as defined in any of claims 29 through 43, wherein the light source and the time-of-flight sensor operate at a frequency that permits multiple determinations of the fluorescent lifetime or the fluorescent intensity of the fluorophore from a sample of the biological material in less than about 1 second, such as less than about 0.5 seconds, such as less than about 10 milliseconds.

45. A system as defined in claim 34, wherein the fluorophore source is configured to place a plurality of fluorophores in association with the biological material, wherein the time-of-flight sensor and one or more processors are configured to determine the fluorescent lifetime or the fluorescent intensity of the

plurality of fluorophores, and wherein the system is configured to determine the fluorescent lifetime or the fluorescent intensity of the plurality of fluorophores simultaneously or in phases.

46. A system as defined in any of claims 29 through 45, wherein the fluorescent emission or phosphorescent emission of the fluorophore is indicative of a parameter related to cellular metabolism, such as a dissolved gas, an ion, a protein, a metabolite, a nucleic acid, an enzyme, pH, an oxidation state, a viscosity, temperature, NAD(P)H, a salt, or a mineral.

47. A system as defined in claim 46, wherein the parameter comprises oxygen partial pressure, pH, an oxidation state, viscosity, or temperature.

48. A method for analyzing biological material comprising:

exposing the biological material to excitation light in a manner that causes a fluorophore in association with the biological material to produce a fluorescent emission or phosphorescent emission;

communicating the fluorescent emission or phosphorescent emission to a time-of-flight sensor;

determining a fluorescence lifetime or a fluorescence intensity of the fluorophore; and

determining a magnitude characteristic of a biological parameter that is related to the determined fluorescent lifetime or the fluorescence intensity.

49. A method as defined in claim 48, wherein the biological material contains living cells comprising bacteria cells, fungus cells, yeast cells, prokaryotic cells, eukaryotic cells, animal cells, human cells, immune cells, or immortal cells.

50. A method as defined in claim 48 or 49, wherein the parameter comprises a dissolved gas, an ion, a protein, a metabolite, a nucleic acid, a lipid, a substrate, a salt, or a mineral.

51. A method as defined in claim 50, wherein the dissolved gas is selected from oxygen, carbon dioxide, nitric oxide, or ammonia.

52. A method as defined in any of claims 48 or 49, wherein the biological material contains cells and the parameter comprises a concentration of a material secreted by the cells into a surrounding media.

53. A method as defined in any of claims 48 through 52, wherein the fluorescence lifetime or the fluorescence intensity of the fluorophore is determined

multiple times in less than about 1 second, such as less than about 0.5 seconds, such as less than about 10 microseconds.

54. A method as defined in any of claims 48 through 53, wherein the magnitude characteristic of the parameter comprises a concentration or a rate of change of the concentration.

55. A method as defined in any of claims 48 through 54, further comprising the step of determining a fluorescence lifetime or a fluorescence intensity of a plurality of fluorophores associated with the biological material simultaneously.

56. A method as defined in any of claims 48 through 55, wherein the fluorescence lifetime of the fluorophore is determined.

57. A method as defined in claim 56, wherein the fluorescence lifetime of the fluorophore is less than about 20 nanoseconds, such as less than about 15 nanoseconds, such as less than about 10 nanoseconds, such as less than about 5 nanoseconds.

58. A method as defined in any of claims 48 through 57, wherein a plurality of fluorophores are placed operative association with a corresponding plurality of samples of the biological material, each sample of the biological material being individually exposed to excitation light in a manner that causes a fluorophore in each sample of biological material to undergo the fluorescent emission or phosphorescent emission, and wherein the plurality of the fluorescent emissions or phosphorescent emissions are sensed and communicated to the time-of-flight sensor for determining the fluorescence lifetime or the fluorescence intensity of the fluorophore from each sample simultaneously.

59. A method for analyzing biological material comprising:

exposing the biological material to excitation light in a manner that causes a fluorophore to produce a fluorescent emission or phosphorescent emission; and

sensing the fluorescent emission or phosphorescent emission and determining a fluorescence lifetime of the fluorophore, the fluorophore being related to a cellular metabolism parameter or a cellular environment parameter and having a fluorescent lifetime of less than about 20 nanoseconds

~~60. A method as defined in claim 59, wherein the biological material contains living cells comprising bacteria cells, fungus cells, yeast cells, prokaryotic cells, eukaryotic cells, animal cells, human cells, immune cells, or immortal cells.~~

~~61. A method as defined in claim 59 or 60, wherein the parameter comprises a dissolved gas, an ion, a protein, a metabolite, a nucleic acid, a lipid, temperature, oxidation state, a substrate, a salt, or a mineral.~~

~~62. A method as defined in claim 61, wherein the dissolved gas is selected from oxygen, carbon dioxide, nitric oxide, or ammonia.~~

~~63. A method as defined in any of claims 59 through 62, wherein the biological material contains cells and the parameter comprises a material secreted by the cells into a surrounding media.~~

~~64. A method as defined in any of claims 59 through 63, wherein the fluorescence lifetime of the fluorophore is determined multiple times in less than about 1 second, such as less than about 0.5 seconds, such as less than about 10 microseconds.~~

~~65. A method as defined in any of claims 59 through 64, further comprising the step of determining the fluorescence lifetime of a plurality of fluorophores in association with the biological material simultaneously.~~

~~66. A method as defined in any of claims 59 through 65, wherein a plurality of fluorophores are placed operative association with a corresponding plurality of samples of biological material, each sample of the biological material being individually exposed to excitation light in a manner that causes a fluorophore in each sample of biological material to undergo a fluorescent emission or phosphorescent emission, and wherein the plurality of fluorescent emissions or phosphorescent emissions are sensed for determining a fluorescence lifetime of the fluorophore from each sample simultaneously.~~

~~67. A method as defined in claim 59, wherein the biological material is contained in a microfluidic device during exposure to the excitation light and is being subject to perfusion.~~

1. A system for analyzing biological material comprising:

a light source configured to emit excitation light onto a biological material sample, the excitation light having a wavelength that causes a fluorophore in

proximity to or within the biological material to undergo a fluorescent emission or phosphorescent emission;

an optical communication path positioned to obtain an optical signal indicative of the fluorescent emission or phosphorescent emission associated with the fluorophore;

a time-of-flight sensor comprising a plurality of pixels configured to receive the signal indicative of the fluorescent emission or phosphorescent emission from the optical communication path, each pixel of the plurality of pixels configured to provide a signal associated with a photo-response of the pixel based at least in part on the optical signal; and

one or more processors in communication with the time-of-flight sensor, the one or more processors configured to determine a fluorescent lifetime or a fluorescent intensity of the fluorophore based at least in part on the photo-response of each pixel.

2. The system as defined in claim 1, further comprising a sample staging site for holding a sample of a biological material.

3. The system as defined in claim 1, wherein the light source and time-of-flight sensor are part of a Light Detection and Ranging (LiDAR) subsystem, and wherein the one or more processors are configured to determine the fluorescent lifetime or the fluorescent intensity of the fluorophore based on the fluorescent emission or phosphorescent emission of the fluorophore.

4. The system as defined in claim 1, wherein the one or more processors are further configured to determine a magnitude characteristic of a biological parameter based on the fluorescent lifetime or the fluorescent intensity.

5. The system as defined in claim 1, wherein the system includes a plurality of samples, each sample being associated with an optical communication path, wherein the pixels of the time-of-flight sensor are divided into a plurality of zones, each optical communication path associated with each sample being in communication with at least one of the plurality of zones, and wherein the time-of-flight sensor and the one or more processors are configured to receive fluorescent emissions or phosphorescent emissions from each sample and determine the fluorescent lifetime or the fluorescent intensity of a fluorophore from each sample.

6. The system as defined in claim 5, further comprising a plurality of staging sites for holding the plurality of samples.

7. The system as defined in claim 1, wherein the light source comprises a laser, a laser diode or a light emitting diode (LED), and wherein the light source is configured to emit the excitation light at a modulation rate; and

wherein the modulation rate is selected based at least in part on the fluorescent lifetime of the fluorescent emission or phosphorescent emission associated with the fluorophore.

8. The system as defined in claim 1, wherein the signal indicative of the photo-response comprises a signal indicative of a response phase for the pixel, and wherein the response phase for a pixel is determined based at least in part by performing operations, the operations comprising:

determining a first response for the pixel from a first analog integrator;

determining a second response for the pixel using a second analog integrator;

determining the response phase based at least in part on the first response and the second response.

9. The system as defined in claim 8, wherein one or more processors are configured to determine the fluorescent lifetime based at least in part on the response phase.

10. The system as defined in claim 1, wherein the system further includes a tray that defines a plurality of sample staging sites, the system further comprising an array of plungers that move relative to the tray, the plungers being spaced apart so as to align with the sample staging sites on the tray, the plungers being configured to move towards the sample staging sites for contacting the biological material located in the sample staging sites, the plungers being in communication with the optical communication path for delivering the excitation light to the biological material and for delivering the fluorescent emission or phosphorescent emission produced by the fluorophore to the time-of-flight sensor.

11. The system as defined in claim 1, wherein the light source and the time-of-flight sensor operate at a frequency that permits multiple determinations of the fluorescent lifetime or the fluorescent intensity of the fluorophore in less than about 1 second.

12. The system as defined in claim 1, wherein the system includes a fluorophore source, and wherein the fluorophore source is configured to place a plurality of fluorophores in association with the biological material, and wherein the

time-of-flight sensor and one or more processors are configured to determine the fluorescent lifetime or the fluorescent intensity of the plurality of fluorophores.

13. The system as defined in claim 1, wherein the time-of-flight sensor and one or more processors are configured to determine the fluorescent lifetime without calibrating the light source between testing of consecutive samples of the biological material.

14. The system as defined in claim 1, wherein the fluorescent emission or phosphorescent emission of the fluorophore is indicative of a parameter related to cellular metabolism, such as a dissolved gas, an ion, a protein, a metabolite, a nucleic acid, an enzyme, pH, an oxidation state, a viscosity, temperature, NAD(P)H, a salt, or a mineral.

15. The system as defined in claim 14, wherein the parameter comprises pH and wherein the flurophore exhibits a fluorescent lifetime of less than 5 nanoseconds.

16. The system as defined in claim 14, wherein the system is further configured to determine a concentration of the parameter or a rate of change of the parameter.

17. A method for analyzing biological material comprising:

exposing the biological material to excitation light in a manner that causes a fluorophore in association with the biological material to produce a fluorescent emission or phosphorescent emission;

communicating the fluorescent emission or phosphorescent emission to a time-of-flight sensor;

determining a fluorescence lifetime or a fluorescence intensity of the fluorophore;

and

determining a magnitude characteristic of a biological parameter that is related to the determined fluorescent lifetime or the fluorescence intensity.

18. The method as defined in claim 17, wherein the biological material contains living cells comprising bacteria cells, fungus cells, yeast cells, prokaryotic cells, eukaryotic cells, animal cells, human cells, immune cells, or immortal cells.

19. The method as defined in claim 17, wherein the parameter comprises a dissolved gas, an ion, a protein, a metabolite, a nucleic acid, a lipid, a substrate, a salt, or a mineral.

20. The method as defined in claim 17, wherein a plurality of fluorophores are placed operative association with a corresponding plurality of samples of the biological material, each sample of the biological material being individually exposed to excitation light in a manner that causes a fluorophore in each sample of biological material to undergo the fluorescent emission or phosphorescent emission, and wherein the plurality of the fluorescent emissions or phosphorescent emissions are sensed and communicated to the time-of-flight sensor for determining the fluorescence lifetime or the fluorescence intensity of the fluorophore from each sample simultaneously.