CLAIMS

1. A modular light device for use in conjunction with an electronic device for treating a biological fluid, wherein the modular light device includes a plurality of components collectively configured to transmit light to one or more biological fluids for treatment, the modular light device comprising:

a housing configured to house one or more components of the modular light device;

a light source array chamber configured to transmit light, wherein the light source array chamber comprises:

one or more light source arrays, each comprising a plurality of light sources configured to generate UV light; and

one or more light sensors configured to detect light;

a window portion configured to pass UV light generated by the plurality of light sources to the one or more biological fluids for treatment; and

a driver communicatively coupled to one or more components of the modular light device and configured to operate the one or more components.

2. The modular light device of claim 1, wherein the light source array chamber comprises one or more temperature sensors configured to measure a temperature.

3. The modular light device of claim 1 or claim 2, wherein each light source of the plurality of light sources emits light having a full-width half-maximum (FWHM) spectral bandwidth of less than 20 nanometers.

4. The modular light device of any one of claims 1-3, wherein each light source of the plurality of light sources is a light-emitting diode (LED).

5. The modular light device of any one of claims 1-4, wherein the one or more light source arrays each comprises a respective first light source channel configured to emit ultraviolet light with a first peak wavelength of the array.

6. The modular light device of any one of claims 1-5, wherein the electronic device comprises a treatment chamber configured to receive at least one of the one or more biological fluids.

7. The modular light device of any one of claims 1-6, wherein the modular light device is configured to be positioned within the electronic device to transmit light to one or more biological fluids in a treatment chamber of the electronic device.

8. The modular light device of any one of claims 1-7, wherein the housing comprises one or more tracks configured to mechanically interface with one or more rails of the electronic device so as to mechanically secure the modular light device when placed into the electronic device.

9. The modular light device of claim 8, wherein the one or more tracks are configured to allow the modular light device to be slideably moveable so to remove and insert the modular light device into the electronic device.

10. The modular light device of any one of claims 1-9, wherein the modular light device comprises one or more heat exchangers configured to transfer heat away from the light source array and/or the modular light device.

11. The modular light device of claim 10, wherein the one or more heat exchangers are configured to exchange heat with air that is passed across the one or more heat exchangers to transfer heat away from the light source array and/or the modular light device.

12. The modular light device of any one of claims 10-11, wherein the one or more heat exchangers are configured to exchange heat with air that is passed across the one or more heat exchangers from one or more fans of the electronic device.

13. The modular light device of any one of claims 1-9, wherein the modular light device comprises one or more fans.

14. The modular light device of any one of claims 1-13, wherein the window portion comprises a window material covering or enclosing an opening of the modular light device, and wherein the window material is made of glass.

15. The modular light device of any one of claims 1-13, wherein the window portion comprises a window material covering or enclosing an opening of the modular light device, and wherein the window material is made of a polymeric material.

16. The modular light device of any one of claims 1-15, wherein the window portion is at least 80% transmissive for UV light of a selected wavelength.

17. The modular light device of any one of claims 1-16, wherein the modular light device comprises one or more light sensors disposed on the one or more of the light source arrays.

18. The modular light device of any one of claims 1-17, wherein the modular light device comprises one or more light sensors disposed at the window portion and configured to detect light generated by the modular light device.

19. The modular light device of any one of claims 1-19, wherein the modular light device comprises one or more circuits disposed at the window portion, and wherein the one or more circuits comprises one or more light sensors disposed on the circuits and configured to detect light generated by the modular light device.

20. The modular light device of claim 19, wherein each of the one or more circuits has a width of 5 millimeters or less, 4 millimeters, or less, or 3 millimeters or less.

21. The modular light device of any one of claims 1-20, wherein the light source array chamber includes a plurality of reflector panels disposed along one or more edges of the light source array chamber.

22. The modular light device of claim 21, wherein the plurality of reflector panels are disposed in the light source array chamber so as to minimize a loss of light energy at a perimeter of the light source array chamber.

23. The modular light device of any one of claims 1-22, wherein one or more light sensors of the light source array chamber are oriented so as to detect light generated by a separate modular light device.

24. The modular light device of any one of claims 1-23, wherein the one or more light sensors are implemented using photodiodes.

25. The modular light device of any one of claims 1-24, wherein the one or more temperature sensors are implemented using thermistors.

26. The modular light device of any one of claims 1-25, wherein one or more of the one or more temperature sensors are configured to measure a temperature at a junction between a light source of the one or more light sources and a printed circuit board (PCB) on which the light source is disposed upon.

27. The modular light device of any one of claims 1-26, wherein the plurality of light sources are configured to generate UV-A light.

28. The modular light device of claim 27, wherein the plurality of light sources are configured to generate light with a first peak wavelength from about 315 nm to about 350 nm.

29. The modular light device of any one of claims 1-26, wherein the plurality of light sources are configured to generate UV-B or UV-C light.

30. The modular light device of any one of claim 5-29, wherein the one or more arrays of light sources each comprises a respective second light source channel configured to emit ultraviolet light with a second peak wavelength of the array, wherein the second peak wavelength differs from the first peak wavelength by at least 5 nanometers.

31. The modular light device of claim 30, wherein the one or more arrays of light sources each comprises a respective first light source channel configured to emit ultraviolet light with a first peak wavelength of the array in the UV-A spectrum, and a respective second light source channel configured to emit ultraviolet light with a second peak wavelength of the array in the UV-B or UV-C spectrum.

32. The modular light device of any one of claims 1-31, wherein the housing comprises one or more electronic interfaces configured to communicatively couple the modular light device to the electronic device.

33. The modular light device of claim 32, wherein the one or more electronic interfaces includes an interlock connection configured to allow the electronic device to turn off the modular light device.

34. The modular light device of claim 32, wherein the one or more electronic interfaces includes a communications port configured to allow the electronic device to transmit commands to the modular light device, and configured to allow for the modular light device to transmit data to the electronic device.

35. The modular light device of claim 32, wherein the one or more electronic interfaces includes a power port configured to transmit power from the electronic device to the modular light device.

36. The modular light device of any one of claims 1-35, wherein a number of light sources of the light source array chamber is configured to provide light for a pre-determined illumination volume to the one or more biological fluids.

37. The modular light device of any one of claims 1-36, wherein the one or more light sources of the light source array chamber collectively generate light such that an irradiance of the light is substantially uniform at a surface of the biological fluid

38. The modular light device of claim 37, wherein a variance in the irradiance of the light across a surface of the biological fluid is less than 25%.

39. The modular light device of any one of claims 1-38, wherein the one or more light sources of the light source array chamber are LEDs configured to have a beam angle of about 110 to about 130 degrees.

40. The modular light device of any one of claims 1-39, wherein a dose of light delivered from the modular light device to a biological fluid during a treatment process is based on light detected by one or more of the one or more light sensors.

41. The modular light device of any one of claims 1-40, wherein an amount of time that the modular light device is activated during a treatment process is based on light detected by one or more of the one or more light sensors.

42. The modular light device of any one of claims 1-41, wherein an intensity of light generated by the modular light device during a treatment process is based on light detected by one or more of the one or more light sensors.

43. The modular light device of any one of claims 1-42, wherein the electronic device for treating a biological fluid comprises a first modular light device oriented to face a biological fluid to be treated, and wherein the first modular light device delivers light to the biological sample for treatment.

44. The modular light device of any one of claims 1-43, wherein the electronic device for treating a biological fluid comprises a first modular light device and a second modular light device, wherein the first and second modular light devices are oriented to face one another, and wherein the first and second modular light devices collectively deliver light to a biological fluid for treatment.

45. The modular light device of claim 44, wherein the first and second light devices are configured to perform a test comprising:

transmitting light from the first modular light device;

detecting the light transmitted by the first device by one or more light sensors of the second modular light device; and

determining the presence or absence of one or more occlusions to the light transmitted by the first modular light device, by comparing the detected light to a pre-determined amount of light.

46. The modular light device of claim 45, wherein the test further comprises:

transmitting light from the second modular light device;

detecting the light transmitted by the second modular light device by one or more light sensors of the first modular light device; and

determining the presence or absence of one or more occlusions to the light transmitted by the second modular light device, by comparing the detected light to a pre-determined level of light.

47. The modular light device of claim 45 or 46, wherein the test further comprises:

determining a baseline amount of light transmitted by the first modular light device to the second modular light device.

48. The modular light device of any one of claims 45-47, wherein the test is a test to determine the presence of an obstructed light path in the electronic device; optionally, to determine the presence of an obstructed light path on a platform or tray of the electronic device.

49. The modular light device of any one of claims 45-47, wherein the test is a test to determine the presence of an obstructed light path in the window portion of the first light device or the second light device.

50. The modular light device of any one of claims 45-47, wherein the test is a test to determine the presence of a biological fluid to be treated in the electronic device.

51. The modular light device of any one of claims 1-50, wherein the modular light device is configured to perform a test comprising:

transmitting light from one or more light source arrays of the light source array chamber of the modular light device;

detecting the light transmitted by the one or more light source arrays by one or more light sensors of the modular light device.

52. The modular light device of claim 51, wherein the one or more light sensors are light sensors disposed at the window portion of the modular light device.

53. The modular light device of claim 51 or claim 52, wherein the test further comprises:

comparing the detected light to a pre-determined amount of light.

54. The modular light device of any one of claims 51-53, wherein the test further comprises one or both of:

a) determining the integrity of one or more of the one or more sensors; and

b) determining the integrity of one or more light sources of the one or more light source arrays.

55. The modular light device of any one of claims 1-54, wherein the modular light device is configured to perform a calibration process comprising:

transmitting light from one or more light source arrays of the modular light device;

receiving data from a calibration device configured to detect the light transmitted by the light source array(s) of the modular light device by one or more light sensors of the calibration device, the calibration device positioned within the electronic device;

comparing the received data to a pre-determined amount of light; and

adjusting the intensity of one or more light sources of the light source array(s) based on the comparison.

56. A method for treating a biological fluid comprising:

providing the biological fluid; and

illuminating the biological fluid with one or more modular light devices of any one of claims 1-55, for a duration and at an intensity sufficient to inactivate a pathogen in the biological fluid.

57. A method for treating a biological fluid comprising:

providing the biological fluid in admixture with a pathogen inactivation compound; and

illuminating the biological fluid with one or more modular light devices of any one of claims 1-55 for a duration and at an intensity sufficient to inactivate a pathogen in the biological fluid.