CLAIMS

1. An optical system comprising:

a plurality of light emitting diodes, respective groups of one or more light emitting diodes of the plurality of light emitting diodes configured to provide light of different wavelengths;

a charge-coupled device configured to receive the light emitted by one or more light emitting diodes of the plurality of light emitting diodes and reflected by an object for fluorescence imaging of the object;

a broadband light source configured to provide broadband light;

a spectrometer configured to receive the broadband light emitted by the broadband light source and reflected by the object for visible-near infrared-shortwave infrared spectroscopy of the object;

a hyperspectral camera configured to receive the broadband light emitted by the broadband light source and reflected by the object for hyperspectral imaging of the object; and

a controller coupled to the plurality of light emitting diodes, the broadband light source, the charge-coupled device, the spectrometer and the hyperspectral camera,

wherein a respective group of one or more light emitting diodes of the plurality of light emitting diodes is configured to be activated to measure or determine a level of a respective substance/chemical in the object,

the optical system further comprising:

a backend module;

a probe; and

a plurality of fibers coupling the backend module and the probe

wherein the backend module comprises the broadband light source, the charge-coupled device, the spectrometer, the hyperspectral camera, and the controller.

2. The optical system according to claim 1,

wherein the probe comprises the plurality of light emitting diodes, and/or wherein the probe comprises an imaging lens.

3. The optical system according to claim 1 or claim 2,

wherein the backend module comprises a light emitting diode driver configured to drive the plurality of light emitting diodes.

4. The optical system according to any one of claims 1 to 3,

wherein the backend module comprises an optical module comprising a fiber collimator, a long-pass filter and a focusing lens.

5. The optical system according to any one of claims 1 to 4,

wherein the fluorescence imaging, the hyperspectral imaging, and the visible-near infrared-shortwave infrared spectroscopy are configured to perform sequential measurements.

6. The optical system according to any one of claims 1 to 5,

wherein the plurality of light emitting diodes is arranged in one or more panels.

7. The optical system according to any of claims 1 to 6,

wherein a respective group of one or more light emitting diodes of the plurality of light emitting diodes is configured to be activated to measure or determine a level of chlorophyll, flavonoid and anthocyanin in the object, respectively.

8. The optical system according to claim 7,

wherein the controller is configured to activate red light and green light of the plurality of light emitting diodes to measure or determine anthocyanin, to activate blue light of the plurality of light emitting diodes to measure or determine chlorophyll, and to activate red light and ultraviolet light of the plurality of light emitting diodes to measure or determine flavonoid in the object.

9. The optical system according to any of claims 1 to 8,

wherein the plurality of light emitting diodes are arranged in multiple panels and each panel comprises a predetermined number of light emitting diodes, and wherein in each panel, the predetermined number of light emitting diodes are spectrally distinct from each other.

10. A method of forming an optical system, the method comprising:

providing a plurality of light emitting diodes respective groups of one or more light emitting diodes of the plurality of light emitting diodes configured to provide light of different wavelengths;

providing a charge-coupled device configured to receive the light emitted by one or more light emitting diodes of the plurality of light emitting diodes and reflected by an object for fluorescence imaging of the object;

providing a broadband light source configured to provide broadband light;

providing a spectrometer configured to receive the broadband light emitted by the broadband light source and reflected by the object for visible-near infrared-shortwave infrared spectroscopy of the object;

providing a hyperspectral camera configured to receive the broadband light emitted by the broadband light source and reflected by the object for hyperspectral imaging of the object;

coupling a controller to the plurality of light emitting diodes, the broadband light source, the charge-coupled device, the spectrometer and the hyperspectral camera; and

activating a respective group of one or more light emitting diodes of the plurality of light emitting diodes to measure or determine a level of a respective substance/chemical in the object,

the method further comprising:

providing a backend module;

providing a probe; and

coupling a plurality of fibers to the backend module and the probe

wherein the backend module comprises the broadband light source, the charge-coupled device, the spectrometer, the hyperspectral camera, and the controller.

11. The method according to claim 10,

wherein the probe comprises the plurality of light emitting diodes.

12. The method according to claim 10 or claim 11,

wherein the backend module comprises a light emitting diode driver configured to drive the plurality of light emitting diodes.

13. The method according to any one of claims 10 to 12,

wherein the backend module comprises an optical module comprising a fiber collimator, a long-pass filter and a focusing lens.

14. The method according to any one of claims 10 to 13,

wherein the probe comprises an imaging lens.

15. The method according to any one of claims 10 to 14,

wherein the plurality of light emitting diodes is arranged in one or more panels.

16. The method according to any one of claims 10 to 15, further comprising:

activating a respective group of one or more emitting diodes of the plurality of light emitting diodes to measure or determine a level of chlorophyll, flavonoid and anthocyanin in the object, respectively.

17. A method of operating an optical system, wherein the optical system comprises: a backend module; a probe; and a plurality of fibers coupling the backend module and the probe, wherein the backend module comprises the broadband light source, a charge-coupled device, a spectrometer, a hyperspectral camera, and the controller, the method comprising:

providing light of different wavelengths using respective groups of one or more light emitting diodes of a plurality of light emitting diodes such that the light emitted by the one or more light emitting diodes of the plurality of light emitting

diodes is reflected by an object and received by the charge-coupled device for fluorescence imaging of the object; and

providing a broadband light using a broadband light source such that the broadband light emitted by the broadband light source is reflected by the object, wherein the reflected broadband light is received by the spectrometer for visible-near infrared-shortwave infrared spectroscopy of the object, and is received by the hyperspectral camera for hyperspectral imaging of the object;

wherein the optical system comprises a controller coupled to the plurality of light emitting diodes, the broadband light source, the charge-coupled device, the spectrometer and the hyperspectral camera;

wherein a respective group of one or more light emitting diodes of the plurality of light emitting diodes is configured to be activated to measure or determine a level of a respective substance/chemical in the object.

18. The method according to claim 17,

wherein the object is a plant.

19. The method according to claim 18,

wherein fluorescence imaging is used to measure chlorophyll, flavonoid and anthocyanin levels of the plant and, wherein a respective combination of UV, blue, green and red lights is used for measuring the chlorophyll, flavonoid and anthocyanin levels of the plant, respectively.

20. The method according to claim 18 or claim 19,

wherein visible-near infrared-shortwave infrared spectroscopy is used to determine plant pigments, polyphenols, water and macro-nutrient levels of the plant.

21. The method according to any one of claims 18 to 20,

wherein hyperspectral imaging is used to determine nitrogen, phosphorous and potassium levels of the plant.