

WHAT IS CLAIMED IS:

1. A multi-color fluorescence detection device, comprising:

a fluorescence chamber adapted for accommodating a fluorescent mixture;

an illumination unit comprising at least one light source and at least one first tunable filter, wherein the light source provides a broad band illumination, and each single of the at least one first tunable filter passes light at different pass bands by being rotated at different angles or moved at different locations to excite the fluorescent mixture;

a detection unit comprising at least one second tunable filter and at least one photo-detector, wherein each single of the at least one second tunable filter passes light emitted from the fluorescent mixture at different pass bands by being rotated at different angles or moved at different locations, and the photo-detector receives fluorescent signals and converts the fluorescent signals to electrical signals; and

an actuation unit adapted for driving the first tunable filter and the second tunable filter to different locations or angles to control variations of pass bands for excitation and emission, respectively.

2. The multi-color fluorescence detection device according to claim 1 wherein the first tunable filter of the illumination unit and the second tunable filter of the detection unit both comprise an angle variable filter or a linear variable filter.

3. The multi-color fluorescence detection device according to claim 1 wherein the maximum pass band of the first tunable filter of the illumination unit and the second tunable filter of the detection unit is 60 nm.

4. The multi-color fluorescence detection device according to claim 1 wherein the light source is an LED.

5. The multi-color fluorescence detection device according to claim 1 wherein a pinhole is provided in front of the first tunable filter in an optical path of the

illumination unit.

6. The multi-color fluorescence detection device according to claim 5 wherein the pinhole has an aperture of 2 ± 0.5 mm in diameter.

7. The multi-color fluorescence detection device according to claim 1 wherein the illumination unit further comprises a focusing optics positioned between the first tunable filter of the illumination unit and the fluorescence chamber.

8. The multi-color fluorescence detection device according to claim 7 wherein a position offset of the focusing optics downward from an optical axis of the light source is 1.3 ± 0.2 mm.

9. The multi-color fluorescence detection device according to claim 1 wherein the fluorescence chamber has a front aperture and a rear aperture.

10. The multi-color fluorescence detection device according to claim 9 wherein the front aperture locates 7 degrees tilted clockwise from a direct optical axis.

11. The multi-color fluorescence detection device according to claim 1 further comprising a heater for providing thermal control for the fluorescence mixture.

12. The multi-color fluorescence detection device according to claim 11 wherein the heater comprises a thermoelectric cooling (TEC) heater.

13. The multi-color fluorescence detection device according to claim 1 wherein the detection unit further comprises a condensing optics positioned between the fluorescence chamber and the second tunable filter of the detection unit.

14. The multi-color fluorescence detection device according to claim 1 wherein the detection unit further comprises an imaging optics positioned between the second tunable filter and the photo-detector of the detection unit.

15. The multi-color fluorescence detection device according to claim 1 wherein the photo-detector comprises a silicon photodiode.

16. The multi-color fluorescence detection device according to claim 1 wherein the

actuation unit comprises a servo motor, a rotary actuator driven by fluid or vacuum pressure, a piezoelectric (PZT) actuator, an electro-actuated polymer (EAP) actuator, or an electromagnetic motor.

17. The multi-color fluorescence detection device according to claim 1 further comprising plural channels positioned linearly, each of which has its own light source, fluorescence chamber, photo-detector and a pair of first and second tunable filters.

18. The multi-color fluorescence detection device according to claim 1 further comprising plural channels positioned linearly, each of which has its own light source, fluorescence chamber and photo-detector, wherein a single pair of first and second tunable filters is moved to scan through the plural channels in turn.

19. The multi-color fluorescence detection device according to claim 1, wherein the first tunable filter of the illumination unit and the second tunable filter of the detection unit both comprise an angle variable filter.

20. The multi-color fluorescence detection device according to claim 1, wherein the actuation unit has plural configurations for detecting plural fluorescent dyes respectively.