of the detection chip 62, and the opening 66 aligns and communicates with at least one reagent cell of the reagent storing body 63 for adding sample to the cartridge 6.

[0024] FIG. 3 shows a schematic view of the multi-color fluorescent excitation and detection device according to the embodiment of the present invention. FIG. 4 is an enlarged schematic view showing the multi-color fluorescent excitation and detection device of FIG. 5. As shown in FIGS. 1, 2, 3 and 4, the multi-color fluorescent excitation and detection device 9 comprises a cartridge 6, at least one illumination module 7, a liquid lens module 5 and at least one detection module 8. Preferably but not exclusively, the multi-color fluorescent excitation and detection device 9 includes four illumination modules 7 and four detection modules 8. Each of the illumination modules 7 is disposed in a corresponding accommodation space 14 of the bottom chamber 12 (see FIG. 2) and provides illumination light at a specified range of wavelengths.

[0025] Please refer to FIG. 4. Each of the detection wells 625 includes a first wall 623, a second wall 621, a third wall 622, a fourth wall 624, a fifth wall and a sixth wall (not shown). The first wall 623 is opposite to the third wall 622. The second wall 621 is opposite to the fourth wall 624. The fifth wall is opposite to the sixth wall. The second wall 621, the fourth wall 624, the fifth wall and the sixth wall are connected with and located between the first wall 623 and the third wall 622. In this embodiment, the first wall 623 is a bottom wall, the second wall 621 is a first lateral wall, the third wall 622 is a top wall, the fourth wall 624 is a second lateral wall, the fifth wall is a third lateral wall, and the sixth wall is a fourth lateral wall.

[0026] FIG. 5 is a schematic view showing the detection wells and the liquid lens module of FIG. 4. As shown in FIGS. 4 and 5, in this

embodiment, the liquid lens module 5 comprises a liquid lens 51 and a first lens 52, and the liquid lens module 5 is configured to enhance the fluorescent signal while the fluorescent signal passes through the second wall 921 and the liquid lens 51. The first lens 52 is a condensing lens and attached on the first wall 623 (i.e. bottom wall) of the detection wells 625. Accordingly, when the illumination light emitted from the illumination module 7 transmits through the first lens 52 attaching on the first wall 623, the illumination light can be concentrated upward to excite the fluorescent sample within the detection well 625 so as to generate a fluorescent signal.

[0027] The liquid lens 51 attached on the second wall 623 (i.e. front wall) of the detection wells 625 and comprises a second lens 511, a liquid layer 512 and a third lens 513. The liquid layer 512 is sandwiched between the second lens and the third lens. In this embodiment, the liquid layer 512 is filled with oil (i.e. mineral oil), but not limited thereto, which can be filled with water, gel or other liquid materials. In some embodiments, the nominal refractive index of the oil filled in the liquid layer 512 is 1.46, and it has at least 0.05 differences with the index of cartridge material.

[0028] In some embodiments, the second lens 511 is used for concentrating light signal in X direction. In other embodiments, the third lens 513 is used for concentrating light signal in Y direction. In this embodiment, the surface of the second lens 511 and the third lens 513 could be a deformable membrane (e.g. thin polymer or soft elastomer). By changing the pressure or volume of the liquid layer 512 between surface the second lens 511 and inner wall of the third lens 513, the curvature of the second lens 511 and the third lens 513 will change. The two optical curvature of the second lens 511 and the third lens 513 with biconic surface design techniques are utilized to fully maximize the optical energy

WHAT IS CLAIMED IS:

1. A multi-color fluorescent excitation and detection device, comprising:

at least one illumination module configured to provide illumination light at a specified range of wavelengths;

a cartridge comprising a detection chip comprising plural detection wells arranged around the peripheral of the detection chip, each of the detection wells being adapted for accommodating a corresponding fluorescent sample therein and includes a first wall and a second wall, the illumination light transmitting through the first wall to excite the fluorescent sample within the detection well so as to generate a fluorescent signal;

a liquid lens module comprising at least one liquid lens attached on the second wall, the liquid lens module being configured to enhance the fluorescent signal while the fluorescent signal passes through the second wall and the liquid lens; and

at least one detection module configured to receive the enhanced fluorescent signal and convert the enhanced fluorescent signal to an electrical signal.

2. The multi-color fluorescent excitation and detection device according to claim 1, wherein the illumination module is located beside the first wall and the optical axis of the illumination module is aligned with the first wall, and wherein the detection module is located beside the second wall and the optical axis of the detection module is aligned with the second wall.

3. The multi-color fluorescent excitation and detection device according to claim 1, wherein the liquid lens module further comprises a first lens attached on the first wall, and the first lens is a condensing lens.

4. The multi-color fluorescent excitation and detection device according to claim 1, wherein the liquid lens further comprises a second lens, a liquid

layer and a third lens, and the liquid layer is sandwiched between the second lens and the third lens.

5. The multi-color fluorescent excitation and detection device according to claim 4, wherein the liquid layer is filled with oil, and the surface of the second lens and the third lens are made of a deformable membrane.

6. The multi-color fluorescent excitation and detection device according to claim 5, wherein the nominal refractive index of the oil filled in the liquid layer is 1.46, and it has at least 0.05 differences with the index of cartridge material.

7. The multi-color fluorescent excitation and detection device according to claim 1, wherein the first wall is a bottom wall and the second wall is a first lateral wall.

8. The multi-color fluorescent excitation and detection device according to claim 7, wherein each of the detection wells further comprises a third wall, a fourth wall, a fifth wall and a sixth wall, the third wall is opposite to the first wall, the second wall is opposite to the fourth wall, the fifth wall is opposite to the sixth wall, wherein the third wall is a top wall, the fourth wall is a second lateral wall, the fifth wall is a third lateral wall, and the sixth wall is a fourth lateral wall.

9. The multi-color fluorescent excitation and detection device according to claim 8, wherein the third wall and the first wall are optical membranes respectively, wherein a thickness of the optical membrane of the third wall and a thickness of the optical membrane of the first wall are ranged from 0.1 mm to 0.2 mm, respectively, wherein a refractive index of the optical membrane of the third wall and a refractive index of the optical membrane of the first wall are ranged from 1.3 to 1.6, respectively.

10. The multi-color fluorescent excitation and detection device according to claim 1, wherein the illumination module comprises:

a light source configured to emit the illumination light at wide bandwidth of wavelengths; and

a first filter arranged between the light source and the first wall and allowing the illumination light at the specified range of wavelengths to pass through.

11. The multi-color fluorescent excitation and detection device according to claim 10, wherein the illumination module further comprises a first pinhole arranged between the light source and the first filter, wherein an aperture of the first pinhole is ranged from 2.0 mm to 3.0 mm.

12. The multi-color fluorescent excitation and detection device according to claim 1, wherein the volume of the detection well is ranged from 10 μL to 50 μL.

13. The multi-color fluorescent excitation and detection device according to claim 1, wherein the detection chip are made of polycarbonate, polymethyl methacrylate or cyclic olefin copolymer, wherein a refractive index of the detection well is ranged from 1.3 to 1.6.

14. The multi-color fluorescent excitation and detection device according to claim 1, wherein the detection module comprises:

a second filter configured to receive the fluorescent signal and allow the fluorescent signal at a specific range of wavelengths to pass through; and

a detector configured to receive the fluorescent signal at the specified range of wavelengths and convert the fluorescent signal to the electrical signal.

15. The multi-color fluorescent excitation and detection device according to claim 14, wherein the detection module further comprises a second pinhole arranged between the second wall and the second filter, wherein an aperture of the second pinhole is ranged from 2.0 mm to 3.0 mm.

16. The multi-color fluorescent excitation and detection device according to claim 12, wherein the detector is a photodiode, an avalanche photodiode, a charge coupled device or a complementary metal-oxide semiconductor.

17. The multi-color fluorescent excitation and detection device according to claim 1, wherein the multi-color fluorescent excitation and detection device is applied in the fields of qPCR, isothermal PCR, fluorescent microscopy or fluorescent spectroscopy.