

[CLAIMS]

1. A reaction processing apparatus comprising:

a reaction processing vessel in which a channel where a sample moves is formed;

a first fluorescence detection device that irradiates a sample inside a first fluorescence detection region set in the channel with first excitation light and also detects first fluorescence produced from the sample by the irradiation with the first excitation light; and

a second fluorescence detection device that irradiates a sample inside a second fluorescence detection region set in the channel with second excitation light and also detects second fluorescence produced from the sample by the irradiation with the second excitation light, wherein

the wavelength range of the first fluorescence and the wavelength range of the second excitation light overlap with each other at least partially,

the first excitation light and the second excitation light flash at a predetermined duty ratio, and

given that the duty ratio of the flashing of the first excitation light and the flashing of the second excitation light is d , the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is set within a range of $2\pi(p_m - \Delta p_m)$ (rad) to $2\pi(p_m + \Delta p_m)$ (rad) or within a range of $2\pi[(1 - p_m) - \Delta p_m]$ (rad) to $2\pi[(1 - p_m) + \Delta p_m]$ (rad), where $p_m = d - d^2$ and $\Delta p_m = 0.01 *$

p_m .

2. A reaction processing apparatus comprising:

a reaction processing vessel in which a channel where a sample moves is formed;

a first fluorescence detection device that irradiates a sample inside a first fluorescence detection region set in the channel with first excitation light and also detects first fluorescence produced from the sample by the irradiation with the first excitation light; and

a second fluorescence detection device that irradiates a sample inside a second fluorescence detection region set in the channel with second excitation light and also detects second fluorescence produced from the sample by the irradiation with the second excitation light, wherein

the wavelength range of the first fluorescence and the wavelength range of the second excitation light overlap with each other at least partially,

the first excitation light and the second excitation light flash at a predetermined duty ratio, and

given that the duty ratio of the flashing of the first excitation light and the flashing of the second excitation light is d , the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is set within a range of $2\pi(p_m - \Delta p_m)$ (rad) to $2\pi(p_m + \Delta p_m)$ (rad) or within a range of $2\pi[(1 - p_m) - \Delta p_m]$ (rad)

to $2\pi[(1 - p_m) + \Delta p_m]$ (rad), where $p_m = d - d^2$ and $\Delta p_m = (d - d^2)/[k * (N_o') / V_0^1]$, N_o' represents noise of a signal output of the first fluorescence detection device when the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is 0 rad, V_0^1 represents a signal output of the first fluorescence detection device when the second fluorescence detection device is not operating, and k is equal to or greater than 20.

3. A reaction processing apparatus comprising:

a reaction processing vessel in which a channel where a sample moves is formed;

a first fluorescence detection device that irradiates a sample inside a first fluorescence detection region set in the channel with first excitation light and also detects first fluorescence produced from the sample by the irradiation with the first excitation light; and

a second fluorescence detection device that irradiates a sample inside a second fluorescence detection region set in the channel with second excitation light and also detects second fluorescence produced from the sample by the irradiation with the second excitation light, wherein

the wavelength range of the first fluorescence and the wavelength range of the second excitation light overlap with each other at least partially,

the first excitation light and the second excitation

light flash at a predetermined duty ratio, and

given that the duty ratio of the flashing of the first excitation light and the flashing of the second excitation light is d , the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is set within a range of $2\pi(p_m - \Delta p_m)$ (rad) to $2\pi(p_m + \Delta p_m)$ (rad) or within a range of $2\pi[(1 - p_m) - \Delta p_m]$ (rad) to $2\pi[(1 - p_m) + \Delta p_m]$ (rad), where $p_m = d - d^2$ and $\Delta p_m = (d - d^2) / [k * (N_o') / V_0^1]$, N_o' represents noise of a signal output of the first fluorescence detection device when the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is 0 rad, V_0^1 represents a signal output of the first fluorescence detection device when the second fluorescence detection device is not operating, and k is 20.

4. A reaction processing apparatus comprising:

a reaction processing vessel in which a channel where a sample moves is formed;

a first fluorescence detection device that irradiates a sample inside a first fluorescence detection region set in the channel with first excitation light and also detects first fluorescence produced from the sample by the irradiation with the first excitation light; and

a second fluorescence detection device that irradiates a sample inside a second fluorescence detection region set in the channel with second excitation light and also detects second

fluorescence produced from the sample by the irradiation with the second excitation light, wherein

the wavelength range of the first fluorescence and the wavelength range of the second excitation light overlap with each other at least partially,

the first excitation light and the second excitation light flash at a predetermined duty ratio, and

given that the duty ratio of the flashing of the first excitation light and the flashing of the second excitation light is d , the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is set within a range of $2\pi(p_m - \Delta p_m)$ (rad) to $2\pi(p_m + \Delta p_m)$ (rad) or within a range of $2\pi[(1 - p_m) - \Delta p_m]$ (rad) to $2\pi[(1 - p_m) + \Delta p_m]$ (rad), where $p_m = d - d_2$ and $\Delta p_m = (d - d_2)/[k * (No') / V_{10}]$, No' represents noise of a signal output of the first fluorescence detection device when the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is 0 rad, V_{10} represents a signal output of the first fluorescence detection device when the second fluorescence detection device is not operating, and k is 100/3.

5. A reaction processing apparatus comprising:

a reaction processing vessel in which a channel where a sample moves is formed;

a first fluorescence detection device that irradiates a

sample inside a first fluorescence detection region set in the channel with first excitation light and also detects first fluorescence produced from the sample by the irradiation with the first excitation light; and

a second fluorescence detection device that irradiates a sample inside a second fluorescence detection region set in the channel with second excitation light and also detects second fluorescence produced from the sample by the irradiation with the second excitation light, wherein

the wavelength range of the first fluorescence and the wavelength range of the second excitation light overlap with each other at least partially,

the first excitation light and the second excitation light flash at a predetermined duty ratio, and

given that the duty ratio of the flashing of the first excitation light and the flashing of the second excitation light is d , the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is set within a range of $2\pi(p_m - \Delta p_m)$ (rad) to $2\pi(p_m + \Delta p_m)$ (rad) or within a range of $2\pi[(1 - p_m) - \Delta p_m]$ (rad) to $2\pi[(1 - p_m) + \Delta p_m]$ (rad), where $p_m = d - d_2$ and $\Delta p_m = (d - d_2) / [k * (No') / V_{10}]$, No' represents noise of a signal output of the first fluorescence detection device when the phase difference between the flashing of the first excitation light and the flashing of the second excitation light is 0 rad, V_{10} represents a signal output of the first fluorescence

detection device when the second fluorescence detection device is not operating, and k is 100.

6. The reaction processing apparatus according to any one of claims 1 through 5, wherein

the first fluorescence detection device includes a first optical head that emits the first excitation light and receives the first fluorescence,

the second fluorescence detection device includes a second optical head that emits the second excitation light and receives the second fluorescence, and

when the respective numerical apertures of the first optical head and the second optical head are in a range of 0.07 to 0.23, the distance between the center of the first fluorescence detection region and the center of the second fluorescence detection region is set to 4 mm or more.

7. The reaction processing apparatus according to any one of claims 1 through 6, wherein

the channel includes a first temperature region maintained at a first temperature, a second temperature region maintained at a second temperature higher than the first temperature, and a connection region connecting the first temperature region and the second temperature region,

the movement of a sample inside the channel is controlled based on a fluorescence signal detected by the first

fluorescence detection device, and

the first fluorescence detection region is set at a substantially intermediate point of the connection region.

8. The reaction processing apparatus according to any one of claims 1 through 7, wherein

the first fluorescence detection device emits blue light as the first excitation light and detects green light as the first fluorescence, and

the second fluorescence detection device emits green light as the second excitation light and detects red light as the second fluorescence.

9. The reaction processing apparatus according to any one of claims 1 through 7, wherein

the first excitation light includes light having a wavelength range of 450 to 490 nm,

the first fluorescence includes light having a wavelength range of 510 to 550 nm,

the second excitation light includes light having a wavelength range of 510 to 550 nm, and

the second fluorescence includes light having a wavelength range of 580 to 640 nm.

10. The reaction processing apparatus according to claim 8, further comprising:

a third fluorescence detection device that irradiates a sample inside a third fluorescence detection region set in the channel with third excitation light and also detects third fluorescence produced from the sample by the irradiation with the third excitation light, wherein

the third fluorescence detection device emits red light as the third excitation light and detects infrared light as the third fluorescence.

11. The reaction processing apparatus according to claim 10, wherein a first optical head of the first fluorescence detection device is arranged in the center and a second optical head of the second fluorescence detection device and a third optical head of the third fluorescence detection device are arranged on the respective sides of the first optical head.