

CLAIMS

1. An apparatus comprising:

a plurality of pixels;

a first reaction site associated to a pixel of the plurality of pixels;

a second reaction site associated to the pixel;

wherein the pixel includes a pixel sensor that detects a read signal, the read signal being dependent on a first cluster signal emitted from the first site and on a second cluster signal emitted from the second site; and

wherein the first site and the second site are configured so that the second cluster signal in an “on” state has a greater amplitude than the first cluster signal in an “on” state.

2. The apparatus of claim 1, wherein the apparatus determines identities of respective analytes in the first reaction site and the second reaction site using a sixteen (16) cloud calling chart that maps signal amplitudes of the read signal under different illumination conditions to identities of respective analytes in the first reaction site and the second reaction site.

3. The apparatus of claim 1, wherein a ratio of the second cluster signal in an “on” state to the first cluster signal in an “on” state is between about 1.9 to about 2.0.

4. The apparatus of claim 1, wherein the second reaction site has a larger size than the first reaction site so that the second cluster signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state.

5. The apparatus of claim 1, wherein the second reaction site has a larger width than the first reaction site so that the second cluster in the “on” state has a greater amplitude than the first cluster signal in the “on” state.

6. The apparatus of claim 1, wherein the second reaction site is absent an attenuator, and wherein the first reaction site includes an attenuator so that the second cluster

signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state.

7. The apparatus of claim 1, wherein, by an arrangement of attenuating material, attenuation of emission light rays radiating from the first reaction site is greater than attenuation of emission light rays radiating from the second reaction site so that the second cluster signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state.

8. The apparatus of claim 1, wherein the second reaction site is absent an attenuator aligned with and below a bottom surface of the second reaction site, and wherein the first reaction site includes an attenuator aligned with and below a bottom surface of the first reaction site so that the second cluster signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state.

9. The apparatus of claim 1, wherein the apparatus includes an attenuating material layer that extends through an area aligned with and below a bottom surface of the first reaction site to define an attenuator of the first reaction site, the attenuating material layer being absent of a section that extends through an area aligned with and below the second reaction site.

10. The apparatus of claim 1, wherein the first reaction site is defined by a first nanowell, and wherein the second reaction site is defined by a second nanowell.

11. The apparatus of claim 10, wherein the second nanowell has a larger size than the first nanowell so that the second cluster signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state.

12. The apparatus of claim 10 characterized by one or more of the following selected from the group consisting of: (a) the second nanowell is absent an attenuator, and the first nanowell includes an attenuator so that the second cluster signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state; (b) the second nanowell is absent an attenuator aligned with and below a bottom surface of the second nanowell, and the first nanowell includes an attenuator aligned with and below a bottom surface of the first nanowell so that the second cluster signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state; and (c) the second nanowell is absent an attenuator

intersected by a vertically extending center axis of the first nanowell, and the first nanowell includes an attenuator intersected by a vertically extending center axis of the first nanowell so that the second cluster signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state.

13. The apparatus of claim 10, wherein the apparatus includes an attenuating material layer that extends through an area aligned with and below a bottom surface of the first nanowell to define an attenuator of the first reaction site, the attenuating material layer being absent of a section that extends through an area aligned with and below the second nanowell.

14. The apparatus of claim 1, wherein second to Nth pixels of the plurality of pixels have associated first and second reaction sites that are respectively configured according to the first reaction site and the second reaction site associated to the pixel, wherein the first and second reaction sites associated to adjacent pixels of the plurality of pixels have first and second different respective orientations relative to their respective pixels, the first and second different respective orientations increasing a spacing distance between reaction sites from adjacent pixel locations relative to a spacing distance between reaction sites from adjacent pixel locations in the absence of the different respective orientations.

15. A method for fabricating the apparatus of claim 1, wherein the method includes depositing in an area aligned with and over a pixel a dielectric stack having integrally formed therein an attenuating material layer; etching in the dielectric stack a first trench for defining the first nanowell, wherein the first trench is etched to an elevation terminating at or above a top elevation of the attenuating material layer so that the attenuating material layer defines an attenuator for the first nanowell; and etching in the dielectric stack a second trench for defining the second nanowell, wherein the second trench is etched to an elevation terminating at or below a bottom elevation of the attenuating material layer.

16. A method comprising:

detecting, using a pixel sensor of a plurality of pixels sensors, a read signal, the read signal being dependent on a first cluster signal emitted from a first reaction site associated to the pixel sensor and on a second cluster signal emitted from a second reaction site associated to the

pixel sensor;

determining an identity of a first analyte of interest in the first reaction site using an amplitude of the read signal detected using the pixel sensor; and

determining an identity of a second analyte of interest in the second reaction site using the amplitude of the read signal detected using the pixel sensor.

17. The method of claim 16, wherein the determining the identity of a first analyte of interest in the first reaction site using an amplitude of the read signal detected using the pixel sensor and the determining the identity of a second analyte of interest in the second reaction site using the amplitude of the detected read signal includes using a calling chart having sixteen (16) signal clouds that map signal amplitudes of the read signal under different illumination conditions to identities of respective analytes in the first reaction site and the second reaction site.

18. The method of claim 16, wherein, by an arrangement of attenuating material, attenuation of emission light rays radiating from the first reaction site is greater than attenuation of emission light rays radiating from the second reaction site so that the second cluster signal in the “on” state has a greater amplitude than the first cluster signal in the “on” state.

19. An apparatus comprising:

a plurality of pixels;

a first reaction site associated to a pixel of the plurality of pixels;

a second reaction site associated to the pixel;

wherein the pixel includes a pixel sensor that detects a read signal, the read signal being dependent on a first cluster signal emitted from the first site and on a second cluster signal emitted from the second site; and

wherein, by an arrangement of attenuating material, attenuation of emission light rays radiating from the first site is greater than attenuation of emission light rays radiating from the second site so that the second cluster signal in an “on” state has a greater amplitude than the first

cluster signal in an “on” state.

20. The apparatus of claim 1, wherein the first cluster signal and the second cluster signal are produced in response to simultaneous excitation of the first reaction site and the second reaction site with excitation light.