

What is claimed is: Claims

1. A device, comprising:

5 a plurality of imaging pixels arranged in a spatial pattern;

a formation of features disposed over the plurality of imaging pixels;

a first feature of the formation of features, the first feature disposed over a first pixel of the plurality of imaging pixels,

a second feature of the formation of features, the second feature disposed over

10 the first pixel and spatially displaced from the first feature;

a first luminophore disposed within or over the first feature;

a second luminophore disposed within or over the second feature; and

a structured illumination source to direct at least a portion of first photons in an illumination pattern to the first feature at a first time, and to direct at least a portion of

15 second photons in the illumination pattern to the second feature at a second time, the second time being different from the first time, the first pixel to selectively receive luminescence emitted by the first luminophore responsive to the portion of the first

photons at the first time, and to selectively receive luminescence emitted by the

second luminophore responsive to the portion of the second photons at the second

20 time, wherein the structured illumination source includes an illumination pattern

generator having an illumination pattern generator actuator connected to the

illumination pattern generator to cause the illumination pattern to translate or rotate

relative to the formation of features; wherein the illumination pattern generator includes

a mask layer and the illumination pattern generator actuator comprises a mask layer

25 actuator connected to the mask layer to translate or rotate the mask layer relative to the formation of features.

2. The device of claim 1, wherein the illumination pattern has illumination

intensity maxima with a periodicity corresponding to a pixel spacing in the spatial

30 pattern of the plurality of imaging pixels.

3. The device of any one of the preceding claims₁ wherein the structured illumination source is to flood illuminate the illumination pattern generator with the first photons and the second photons.

5 4. The device of any one of the preceding claims₁ wherein the structured illumination source comprises a laser.

~~5. The device of any of the preceding claims wherein the illumination pattern generator includes a mask layer and the illumination pattern generator actuator~~
10 ~~comprises a mask layer actuator connected to the mask layer to translate or rotate the mask layer relative to the formation of features.~~

65. The device of claim ~~51~~, wherein:
a first position of the mask layer causes the portion of the first photons to
15 selectively illuminate the first feature; and
a second position of the mask layer causes the portion of the second photons to selectively illuminate the second feature.

76. The device of claim ~~51~~ or claim ~~65~~, wherein:
20 the mask layer includes a grate of alternating, periodically-spaced, light-transmitting regions and opaque regions;
the light-transmitting regions are defined by parallel strips of a mask absorber disposed on a mask substrate; and
the portion of the first photons and the portion of the second photons are
25 transmitted through the light-transmitting regions to illuminate parallel illumination stripes on the formation of features.

87. The device of claim ~~51~~ or claim ~~65~~, wherein:
the mask layer includes a two-dimensional arrangement of periodically-spaced,
30 light-transmitting regions defined on an opaque field region;

the opaque field region is defined by a mask absorber disposed on a mask substrate;

the light-transmitting regions are zones of the mask substrate defined in the opaque field region, the zones having the mask absorber excluded from being disposed thereon; and

the portion of the first photons and the portion of the second photons are transmitted through the light-transmitting regions to illuminate corresponding features on the formation of features.

98. The device of any one of claims 1 to 4, wherein the illumination pattern generator comprises:

an interference pattern generator to propagate light defining a multi-beam interference pattern on the formation of features;

wherein the illumination pattern generator actuator comprises an interference pattern generator actuator connected to the interference pattern generator to change a positional state or rotational state of the interference pattern generator to cause the interference pattern to translate or rotate relative to the formation of features.

~~109~~. The device of claim ~~98~~, wherein:

a first positional state or rotational state of the interference pattern generator causes the portion of the first photons to selectively illuminate the first feature; and

a second positional state or rotational state of the interference pattern generator causes the portion of the second photons to selectively illuminate the second feature.

~~1110~~. The device of claim ~~98~~ or claim ~~109~~, wherein:

the multi-beam interference pattern is a two-beam interference pattern;

the interference pattern generator is to project parallel linear interference fringes on the formation of features; and

the parallel linear interference fringes have a predetermined periodicity equal to a pixel spacing.

1211. The device of claim 98 or claim 109, wherein:
the multi-beam interference pattern is an interference pattern from at least four interfering beams; and
the interference pattern is a two-dimensional interference pattern having
5 interference maxima with a predetermined periodicity equal to a pixel spacing.

1312. The device of claim 98 or claim 109, wherein the interference pattern generator includes a two-dimensional transmission phase mask to split a laser beam into a set of interfering beams.

1413. The device of any one of the preceding claims, wherein: the structured illumination source comprises an optical component; and the device further comprises a controller coupled to the optical component to control the optical component so as to direct the portion of the first photons in the illumination pattern to the first feature at the
15 first time and to direct the portion of the second photons in the illumination pattern to the second feature at the second time.

1514. The device of claim 1413, wherein the optical component comprises a beam steering component.

1615. The device of any one of the preceding claims wherein the second feature is laterally displaced from the first feature.

1716. The device of any one of the preceding claims, further comprising:
25 a third feature of the formation of features disposed over the first pixel and spatially displaced from each of the first features and second features;
a third luminophore disposed within or over the third feature;
the structured illumination source to direct at least a portion of third photons to the third feature at a third time, the third time being different from the first time and
30 second time; and

the first pixel to selectively receive luminescence emitted by the third luminophore responsive to the portion of the third photons at the third time.

~~18~~17. The device of claim ~~17~~16, further comprising:

5 a fourth feature of the formation of features disposed over the first pixel and spatially displaced from each of the first features, second features, and third features;

a fourth luminophore disposed within or over the fourth feature;

the structured illumination source to direct at least a portion of fourth photons to the fourth feature at a fourth time, the fourth time being different from the first time,
10 second time, and third time; and

the first pixel to selectively receive luminescence emitted by the fourth luminophore responsive to the portion of the fourth photons at the fourth time.

~~19~~18. The device of any one of the preceding claims, wherein the first and
15 second photons have wavelengths in a range from about 300 nm to about 800 nm.

~~20~~19. A method, comprising:

directing, by a structured illumination source, at least a portion of first photons in an illumination pattern to a first feature at a first time, wherein the first feature is a
20 member of a formation of features disposed over a plurality of imaging pixels arranged in a spatial pattern in a luminescent imaging device, and wherein the first feature of the formation of features is disposed over a first pixel of the plurality of imaging pixels;

directing, by the structured illumination source, at least a portion of second photons in the illumination pattern to a second feature at a second time, the second
25 time being different from the first time, wherein the second feature is a member of the formation of features, and wherein the second feature of the formation of features is disposed over the first pixel and spatially displaced from the first feature;

selectively receiving, by the first pixel, luminescence emitted by a first luminophore responsive to the portion of the first photons at the first time, wherein the
30 first luminophore is disposed within or over the first feature; and

selectively receiving, by the first pixel, luminescence emitted by a second luminophore responsive to the portion of the second photons at the second time, wherein the second luminophore is disposed within or over the second feature, wherein the structured illumination source includes an illumination pattern generator
5 having an illumination pattern generator actuator connected to the illumination pattern generator to cause the illumination pattern to translate or rotate relative to the formation of features; wherein the illumination pattern generator includes a mask layer and the illumination pattern generator actuator comprises a mask layer actuator connected to the mask layer to translate or rotate the mask layer relative to the
10 formation of features.

2120. The method of claim 2019, wherein the illumination pattern has illumination intensity maxima with a periodicity corresponding to a pixel spacing in the spatial pattern of the plurality of imaging pixels.

2221. The method of claim 2019 or claim 2120, wherein:
the illumination pattern generator includes a mask layer and the illumination pattern generator actuator comprises a mask layer actuator connected to the mask layer to translate or rotate the mask layer relative to the formation of features;
20 a first position of the mask layer causes the portion of the first photons to selectively illuminate the first feature;
a second position of the mask layer causes the portion of the second photons to selectively illuminate the second feature;
the mask layer includes a grate of alternating, periodically-spaced, light-
25 transmitting regions and opaque regions;
the light-transmitting regions are defined by parallel strips of a mask absorber disposed on a mask substrate; and
the portion of the first photons and the portion of the second photons are transmitted through the light-transmitting regions to illuminate parallel illumination
30 stripes on the formation of features.

2322. The method of claim 2019 or claim 2120, wherein the illumination pattern generator comprises:

an interference pattern generator to propagate light defining a multi-beam interference pattern on the formation of features;

5 wherein the illumination pattern generator actuator comprises an interference pattern generator actuator connected to the interference pattern generator to change a positional state or rotational state of the interference pattern generator to cause the interference pattern to translate or rotate relative to the formation of features.

10 2423. A device, comprising:

a plurality of imaging pixels arranged in a spatial pattern;

a formation of features disposed over the plurality of imaging pixels;

an illumination pattern generator;

15 a first feature of the formation of features, the first feature being disposed over a first pixel of the plurality of imaging pixels; and

a second feature of the formation of features, the second feature disposed over the first pixel and spatially displaced from the first feature;

20 wherein the illumination pattern generator includes an illumination pattern generator actuator connected to the illumination pattern generator to cause an illumination pattern having an illumination intensity maxima with a periodicity corresponding to a pixel spacing in the spatial pattern of the plurality of imaging pixels to selectively irradiate the first feature with light at a first time;

25 and wherein the illumination pattern generator causes the illumination pattern to selectively irradiate the second feature with light at a second time, the second time being different from the first time; wherein the illumination pattern generator includes a mask layer and the illumination pattern generator actuator comprises a mask layer actuator connected to the mask layer to translate or rotate the mask layer relative to the formation of features.

30 2524. The device of claim 2423, further comprising:

a structured illumination source to generate first photons at the first time, and to generate second photons at the second time;

a first luminophore disposed within or over the first feature and a second luminophore disposed within or over the second feature;

- 5 a first target analyte disposed within or over the first feature and a second target analyte disposed within or over the second feature, wherein the first target analyte is different from the second target analyte; and

the first target analyte and second target analyte comprise nucleic acids having different sequences.