

CLAIMS

1. A microfabricated optical structure, comprising:
a substrate having a plurality of pixels wherein two or more of the plurality of pixels each comprise:
a reaction chamber configured to hold a specimen for analysis;
a waveguide configured to deliver excitation radiation to the reaction chamber;
an optical sensor configured to detect emission radiation emitted from the reaction chamber; and
a microdisk disposed between the waveguide and the optical sensor and configured to increase an amount of the emission radiation that is received by the optical sensor compared to an amount of the emission radiation that would be received by the optical sensor without the microdisk.
2. The microfabricated structure of claim 1, wherein the microdisk forms a resonant cavity for collecting and reradiating the emission radiation.
3. The microfabricated structure of claim 1, wherein the microdisk is surrounded by at least one concentric ring configured increase the amount of the emission radiation that is received by the optical sensor.
4. The microfabricated structure of claim 3, wherein the at least one concentric ring comprises a same material as the microdisk.
5. The microfabricated structure of any one of claims 1 through 4, wherein the microdisk comprises a dielectric material having a first index of refraction that is different from a second index of refraction for material surrounding the microdisk.
6. The microfabricated structure of any one of claims 1 through 4, wherein the microdisk comprises an oxide or nitride material.
7. The microfabricated structure of any one of claims 1 through 4, wherein the microdisk is formed from silicon nitride.
8. The microfabricated structure of any one of claims 1 through 4, wherein the microdisk is disposed between 500 nm and 1500 nm below the waveguide.

9. The microfabricated structure of any one of claims 1 through 4, wherein the microdisk has a thickness between 100 nm and 800 nm.
10. The microfabricated structure of any one of claims 1 through 4, wherein the microdisk has an elliptical cross-section taken in a plane parallel to a surface of the substrate.
11. The microfabricated structure of any one of claims 1 through 4, wherein the microdisk has a circular cross-section taken in a plane parallel to a surface of the substrate.
12. The microfabricated structure of claim 11, wherein the microdisk has a diameter between 0.5 μ m and 2 μ m.
13. The microfabricated structure of any one of claims 1 through 4, further comprising an optical filter disposed below the microdisk that is configured to reduce excitation radiation incident on the optical sensor.
14. The microfabricated structure of claim 13, wherein the optical filter comprises a microfabricated structure having periodic modulations in refractive index values in two or three dimensions.
15. The microfabricated structure of any one of claims 1 through 4, further comprising at least one iris layer disposed below the microdisk and configured to allow the emission radiation from the reaction chamber to reach the optical sensor while blocking at least some scattered excitation radiation from reaching the optical sensor.
16. The microfabricated structure of any one of claims 1 through 4, further comprising complementary metal-oxide-semiconductor (CMOS) circuitry integrated on the substrate and connected to the optical sensor.
17. The microfabricated structure of any one of claims 1 through 4, wherein the waveguide is arranged to deliver excitation radiation to a plurality of the pixels.
18. A method of operating an integrated device, the method comprising:
 - delivering excitation radiation from an optical waveguide to a reaction chamber, wherein the optical waveguide and reaction chamber are integrated on a substrate of the integrated device;
 - passing emission radiation from the reaction chamber through a microdisk to a sensor that is integrated on the substrate; and
 - increasing with the microdisk an amount of the emission radiation received by the sensor compared to an amount of the emission radiation that would be received without the microdisk.

19. The method of claim 18, further comprising passing the emission radiation from the reaction chamber through an iris.
20. The method of claim 19, further comprising blocking, at least in part, the excitation radiation with the iris.
21. The method of claim 18, further comprising passing the emission radiation from the reaction chamber through a discriminating optical structure.
22. The method of any one of claims 18 through 21, wherein the microdisk comprises a dielectric material having a first index of refraction that is different from a second index of refraction for material surrounding the microdisk.
23. The method of any one of claims 18 through 21, wherein the microdisk comprises an oxide or nitride material.
24. The method of claim 23, wherein the microdisk is formed from silicon nitride.
25. A method for fabricating an integrated device, the method comprising:
 - forming, at each of a plurality of pixels on a substrate, a reaction chamber, an optical waveguide arranged to deliver excitation radiation to the reaction chamber, and an optical sensor arranged to receive emission radiation from the reaction chamber; and
 - forming a microdisk at each pixel between the optical waveguide and the optical sensor, wherein the microdisk is configured to increase an amount of the emission radiation that is received by the optical sensor compared to an amount of the emission radiation that would be received without the microdisk.
26. The method of claim 25, wherein forming the microdisk comprises depositing a first dielectric material onto the substrate and etching said first dielectric material to form voids in the first dielectric material.
27. The method of claim 26, wherein forming the microdisk further comprises filling the voids in the first dielectric material with a second material different than the first dielectric material.
28. The method of claim 27, wherein the first dielectric material has a first index of refraction and the second material has a second index of refraction different from the first index of refraction.

29. The method of any one of claims 26 through 28, wherein the first dielectric material is silicon nitride.
30. The method of any one of claims 25 through 28, further comprising forming at least one iris layer prior to forming the microdisk at each pixel.
31. The method of any one of claims 25 through 28, further comprising forming an optical filter prior to forming the microdisk at each pixel.
32. The method of any one of claims 25 through 28, further comprising performing a planarization process prior to forming the optical waveguide at each pixel.