**CLAIMS**

1. An optical sensing system, the optical sensing system comprising:

a light separation element configured to separate an input light into a plurality of sliced lights, each sliced light of the plurality of sliced lights having a different range of wavelengths;

a plurality of first resonators, each first resonator of the plurality of first resonators configured to receive one respective sliced light of the plurality of sliced lights, wherein an effective refractive index of each first resonator is changeable in response to a change in a refractive index of a cladding of the respective first resonator;

at least one second resonator coupled to the plurality of first resonators;

a plurality of detectors, wherein one respective detector of the plurality of detectors is configured to measure a respective intensity of the respective sliced light based on a difference between a resonant wavelength of each first resonator and a resonant wavelength of the at least one second resonator;

wherein the difference between the resonant wavelength of each first resonator and the resonant wavelength of the at least one second resonator is based on the effective refractive index of each first resonator.

2. The optical sensing system according to claim 1,

wherein the resonant wavelength of the second resonator is adjustable to a current or voltage applied to the second resonator.

3. The optical sensing system according to claim 1 or claim 2,

wherein the plurality of first resonators is coupled to the light separation element such that each first resonator of the plurality of first resonators is

configured to receive one respective sliced light of the plurality of sliced lights.

4. The optical sensing system according to claim 3, the optical sensing system further comprising:

a plurality of channel waveguides, each first resonator of the plurality of first resonators coupled to one respective channel waveguide of the plurality of channel waveguides;

wherein the respective channel waveguide is configured to couple the respective sliced light between the light separation element and the respective first resonator.

5. The optical sensing system according to claim 3 or claim 4, the optical sensing system further comprising:

a plurality of output waveguides;

wherein one respective output waveguide of the plurality of output waveguides is coupled to each first resonator, the respective output waveguide configured to carry the respective sliced light from each first resonator; and

wherein the respective detector is coupled to the respective output waveguide; wherein the respective detector is configured to receive the respective sliced light from the respective output waveguide.

6. The optical sensing system according to any of claims 3 to 5,

wherein the respective intensity of the respective sliced light is based on a respective difference between a respective resonant wavelength of each first resonator and the resonant wavelength of the second resonator;

wherein the respective difference between the respective resonant wavelength of each first resonator and the resonant wavelength of the second

resonator is based on a respective effective refractive index of the respective first resonator.

7. The optical sensing system according to claim 6,

wherein the respective effective refractive index of each first resonator is changeable in response to a change in a respective refractive index of a respective cladding of each first resonator.

8. The optical sensing system according to any of claim 3 to 7,

wherein the optical sensing system further comprises a coupling waveguide coupling the second resonator and the light separation element.

9. The optical sensing system according to claim 8, the optical sensing system further comprising:

an optical broadband source; and

an input waveguide coupling the optical broadband source to the second resonator.

10. The optical sensing system according to claim 1 or claim 2, the optical sensing system further comprising:

one or more further second resonators such that the optical sensing system comprises a plurality of second resonators, the plurality of second resonators coupled to the light separation element such that each second resonator of the plurality of second resonators is configured to receive one respective sliced light of the plurality of sliced light.

11. The optical sensing system according to claim 10,

wherein one respective first resonator of the plurality of first resonators coupled to each second resonator such that the respective first resonator receives the respective sliced light from each second resonator.

12. The optical sensing system according to claim 11, the optical sensing system further comprising:

a plurality of coupling waveguides;

wherein one respective coupling waveguide of the plurality of coupling waveguides couples between each second resonator and the respective first resonator, the respective coupling waveguide configured to carry the respective sliced light from each second resonator to the respective first resonator.

13. The optical sensing system according to any of claims 10 to 12, the optical sensing system further comprising:

a plurality of output waveguides;

wherein one respective output waveguide of the plurality of output waveguides is coupled to the respective first resonator, the respective output waveguide configured to carry the respective sliced light from the respective first resonator; and

wherein the respective detector is coupled to the respective output waveguide; wherein the respective detector is configured to receive the respective sliced light from the respective output waveguide.

14. The optical sensing system according to any of claims 10 to 13,

wherein the respective intensity of the respective sliced light is based on a respective difference between a respective resonant wavelength of the respective first resonator and a respective resonant wavelength of each second resonator;

wherein the respective difference between the respective resonant wavelength of the respective first resonator and the respective resonant wavelength of each second resonator is based on a respective effective refractive index of the respective first resonator.

15. The optical sensing system according to claim 14,

wherein the respective effective refractive index of the respective first resonator is changeable in response to a change in a respective refractive index of a respective cladding of the respective first resonator.

16. The optical sensing system according to any of claims 10 to 15, the optical sensing system further comprising:

an optical broadband source; and

an input waveguide coupling the optical broadband source to the light separation element.

17. The optical sensing system of any of claims 2 to 16,

wherein each second resonator comprises a thermal heater, and wherein the current or voltage being adjustable in response to the change in the effective refractive index of the first resonator is applied to the heater.

18. A method of determining a change in an effective refractive index of ~~a~~one first resonator of a plurality of first resonators in an optical sensing system, the method comprising:

separating an input light into a plurality of sliced lights, each sliced light of the plurality of sliced lights having a different range of wavelengths;

coupling one sliced light of the plurality of sliced lights through the one first resonator of the plurality of first resonators to one detector of a plurality of detectors of the optical sensing system;

coupling another sliced light of the plurality of sliced lights through another first resonator of the plurality of first resonators to another detector of the plurality of detectors of the optical sensing system;

placing a sample in contact with the one first resonator of the plurality of first resonators;

placing a reference sample in contact with the another first resonator of the plurality of first resonators;

measuring a change in an intensity of the one sliced light by the one detector due to the sample being placed in contact with the one first resonator of the plurality of first resonators, the change in intensity based on a change in a difference between a resonant wavelength of the one first resonator of the plurality of first resonators and a resonant wavelength of a second resonator;

measuring a change in a further intensity of the another sliced light due to the reference sample being placed in contact with the another first resonator of the plurality of first resonators;

and

determining the change in an effective refractive index of the one first resonator of the plurality of first resonators based on the change in the intensity of the one sliced light, the change in the further intensity of the another sliced light, and a predetermined change in a further effective refractive index of the another first resonator of the plurality of first resonators.

**CLAIMS**

1. An optical sensing system, the optical sensing system comprising:

a light separation element configured to separate an input light into a plurality of sliced lights, each sliced light of the plurality of sliced lights having a different range of wavelengths;
a plurality of first resonators, each first resonator of the plurality of first resonators configured to receive one respective sliced light of the plurality of sliced lights, wherein an effective refractive index of each first resonator is changeable in response to a change in a refractive index of a cladding of the respective first resonator; and wherein at least one first resonator of the plurality of first resonators is configured to contact a sample so that a refractive index of a cladding of the at least one first resonator is changed as a result of the at least one first resonator brought into contact with the sample;
at least one second resonator coupled to the plurality of first resonators;
a plurality of detectors, wherein one respective detector of the plurality of detectors is configured to measure a respective intensity of the respective sliced light based on a difference between a resonant wavelength of each first resonator and a resonant wavelength of the at least one second resonator;
wherein the difference between the resonant wavelength of each first resonator and the resonant wavelength of the at least one second resonator is based on the effective refractive index of each first resonator.

2. The optical sensing system according to claim 1,

wherein the resonant wavelength of the second resonator is adjustable

to a current or voltage applied to the second resonator.

3. The optical sensing system of claim 2,

wherein each second resonator comprises a thermal heater, and

wherein the current or voltage being adjustable in response to the change in the effective refractive index of the first resonator is applied to the heater.

4. The optical sensing system according to claim 1,

wherein the plurality of first resonators is coupled to the light separation element such that each first resonator of the plurality of first resonators is configured to receive one respective sliced light of the plurality of sliced lights.

5. The optical sensing system according to claim 4, the optical sensing system further comprising:

a plurality of channel waveguides, each first resonator of the plurality of first resonators coupled to one respective channel waveguide of the plurality of channel waveguides;
wherein the respective channel waveguide is configured to couple the respective sliced light between the light separation element and the respective first resonator.

6. The optical sensing system according to claim 4, the optical sensing system further comprising:

a plurality of output waveguides;
wherein one respective output waveguide of the plurality of output waveguides is coupled to each first resonator, the respective output waveguide configured to carry the respective sliced light from each first resonator; and
wherein the respective detector is coupled to the respective output

waveguide; wherein the respective detector is configured to receive the respective sliced light from the respective output waveguide.

7. The optical sensing system according to claim 4,

wherein the respective intensity of the respective sliced light is based on a respective difference between a respective resonant wavelength of each first resonator and the resonant wavelength of the second resonator;
wherein the respective difference between the respective resonant wavelength of each first resonator and the resonant wavelength of the second resonator is based on a respective effective refractive index of the respective first resonator.

8. The optical sensing system according to claim 7,

wherein the respective effective refractive index of each first resonator is changeable in response to a change in a respective refractive index of a respective cladding of each first resonator.

9. The optical sensing system according to claim 4,

wherein the optical sensing system further comprises a coupling waveguide coupling the second resonator and the light separation element.

10. The optical sensing system according to claim 9, the optical sensing system further comprising:

an optical broadband source; and
an input waveguide coupling the optical broadband source to the second resonator.

11. The optical sensing system according to claim 1, the optical sensing system further comprising:

one or more further second resonators such that the optical sensing system comprises a plurality of second resonators, the plurality of second resonators coupled to the light separation element such that each second resonator of the plurality of second resonators is configured to receive one respective sliced light of the plurality of sliced light.

12. The optical sensing system according to claim 11,

wherein one respective first resonator of the plurality of first resonators coupled to each second resonator such that the respective first resonator receives the respective sliced light from each second resonator.

13. The optical sensing system according to claim 12, the optical sensing system further comprising:

a plurality of coupling waveguides;
wherein one respective coupling waveguide of the plurality of coupling waveguides couples between each second resonator and the respective first resonator, the respective coupling waveguide configured to carry the respective sliced light from each second resonator to the respective first resonator.

14. The optical sensing system according to claim 11, the optical sensing system further comprising:

a plurality of output waveguides;
wherein one respective output waveguide of the plurality of output waveguides is coupled to the respective first resonator, the respective output

waveguide configured to carry the respective sliced light from the respective first resonator; and

wherein the respective detector is coupled to the respective output waveguide; wherein the respective detector is configured to receive the respective sliced light from the respective output waveguide.

15. The optical sensing system according to claim 11,

wherein the respective intensity of the respective sliced light is based on a respective difference between a respective resonant wavelength of the respective first resonator and a respective resonant wavelength of each second resonator;

wherein the respective difference between the respective resonant wavelength of the respective first resonator and the respective resonant wavelength of each second resonator is based on a respective effective refractive index of the respective first resonator.

16. The optical sensing system according to claim 15,

wherein the respective effective refractive index of the respective first resonator is changeable in response to a change in a respective refractive index of a respective cladding of the respective first resonator.

17. The optical sensing system according to claim 11, the optical sensing system further comprising:

an optical broadband source; and

an input waveguide coupling the optical broadband source to the light separation element.

18. A method of determining a change in an effective refractive index of one first resonator of a plurality of first resonators in an optical sensing system, the method comprising:

separating an input light into a plurality of sliced lights, each sliced light of the plurality of sliced lights having a different range of wavelengths;
coupling one sliced light of the plurality of sliced lights through the one first resonator of the plurality of first resonators to one detector of a plurality of detectors of the optical sensing system;
coupling another sliced light of the plurality of sliced lights through another first resonator of the plurality of first resonators to another detector of the plurality of detectors of the optical sensing system;
placing a sample in contact with the one first resonator of the plurality of first resonators so that a refractive index of a cladding of the one first resonator is changed as a result of the one first resonator brought into contact with the sample;
placing a reference sample in contact with the another first resonator of the plurality of first resonators so that a refractive index of a cladding of the another first resonator is changed as a result of the another first resonator brought into contact with the reference sample;
measuring a change in an intensity of the one sliced light by the one detector due to the sample being placed in contact with the one first resonator of the plurality of first resonators, the change in intensity based on a change in a difference between a resonant wavelength of the one first resonator of the plurality of first resonators and a resonant wavelength of a second resonator;
measuring a change in a further intensity of the another sliced light due to the reference sample being placed in contact with the another first resonator of the plurality of first resonators; and
determining the change in an effective refractive index of the one first resonator of the plurality of first resonators based on the change in the intensity of the one sliced light, the change in the further intensity of the

another sliced light, and a predetermined change in a further effective refractive index of the another first resonator of the plurality of first resonators.