[007] Micro-ring resonators (especially Si micro-rings) have found numerous applications, which offer high quality factor (Q) and a compact size making such structures attractive for telecommunications and sensing applications. Micro-ring resonator based sensors use a wavelength-shift scheme, which is very useful for simultaneously reducing noise and enhancing sensitivity. Optical sensors are particularly viable for silicon photonics since crystalline silicon has superior optical properties, including high refractive index and low optical loss, which are not attainable with plastic materials. For Si waveguide-based sensors, the evanescent optical field expanded outside the Si waveguide can sense the surrounding variations. Moreover, devices having a ring-resonator configuration can further amplify the sensing response as light circulating inside the ring effectively and multiply interacts with the surroundings. Furthermore, high quality factor (Q) ring resonators have a longer effective interaction length with the surroundings, leading to an increase in sensitivity.

[008] A need therefore exists to provide micro-machined optical pressure sensors that seek to address at least the above-mentioned problems.

SUMMARY

[009] According to an aspect of the invention, there is provided a micro-machined optical pressure sensor, comprising: a diaphragm configured to deform when a force is applied thereto; a sensing micro-ring spaced apart from the diaphragm by a gap, the gap being variable depending on the force applied on the diaphragm; and a reference micro-ring spaced apart from the sensing micro-ring, the reference micro-ring configured to produce a reference resonance wavelength shift, the reference resonance wavelength shift indicative of the temperature of the micro-machined optical pressure sensor; wherein the sensing micro-ring is configured to produce a resonance wavelength shift when the gap is varied, the resonance wavelength shift indicative of the force applied to the diaphragm, wherein the reference micro-ring is configured to compensate a temperature-dependent resonance shift within the resonance wavelength shift produced by the sensing micro-ring when the gap is varied.

[010]

[011] In an embodiment, an effective resonance wavelength shift may be derived from the resonance wavelength shift and the reference resonance

wavelength shift, the effective resonance wavelength shift indicative of the force applied on the diaphragm independent of the temperature of the sensor.

CLAIMS

1. A micro-machined optical pressure sensor, comprising:

a diaphragm configured to deform when a force is applied thereto;

a sensing micro-ring spaced apart from the diaphragm by a gap, the gap being variable depending on the force applied on the diaphragm; and

a reference micro-ring spaced apart from the sensing micro-ring, the reference micro-ring configured to produce a reference resonance wavelength shift, the reference resonance wavelength shift indicative of the temperature of the micro-machined optical pressure sensor;

wherein the sensing micro-ring is configured to produce a resonance wavelength shift when the gap is varied, the resonance wavelength shift indicative of the force applied to the diaphragm,

wherein the reference micro-ring is configured to compensate a temperature-dependent resonance shift within the resonance wavelength shift produced by the sensing micro-ring when the gap is varied.

2. The sensor as claimed in claim 1, further comprising a waveguide, wherein the sensing micro-ring and the reference micro-ring are in optical communication with the waveguide.

3. The sensor as claimed in claim 1, wherein an effective resonance wavelength shift is derived from the resonance wavelength shift and the reference resonance wavelength shift, the effective resonance wavelength shift indicative of the force applied on the diaphragm independent of the temperature of the sensor.

4. The sensor as claimed in claim 1, further comprising a waveguide, wherein the sensing micro-ring and the reference micro-ring are in optical communication with the waveguide.

5. The sensor as claimed in claim 4, further comprising a broadband light source in optical communication with the waveguide for providing an optical spectrum from which the resonance wavelength shift and the reference resonance wavelength shift are derived.

6. The sensor as claimed in claim 4, further comprising a substrate, wherein the sensing micro-ring and the waveguide are fixedly disposed within the substrate such that the spacing between the sensing micro-ring and the waveguide does not vary when force is applied to the diaphragm.

7. The sensor as claimed in claim 6, wherein the substrate comprises SiO_2.

8. The sensor as claimed in claim 1, wherein the diaphragm comprises Si_3N_4.

9. The sensor as claimed in claim 1, wherein the diaphragm comprises SiO_2.

10. The sensor as claimed in claim 6, wherein the substrate comprises a leakage channel for air pressure balance.

11. The sensor as claimed in claim 4, further comprising an auxiliary waveguide, wherein the sensing micro-ring is in optical communication with the auxiliary waveguide.

12. The sensor as claimed in claim 11, further comprising a broadband light source in optical communication with both the waveguide and the auxiliary waveguide for providing an optical spectrum from which the resonance wavelength shift and the reference resonance wavelength shift are derived.

13. The sensor as claimed in claim 12, further comprising a substrate, wherein the sensing micro-ring, the waveguide and the auxiliary waveguide are fixedly disposed within the substrate such that the spacings between the sensing micro-ring, the waveguide and the auxiliary waveguide do not vary when force is applied to the diaphragm.

14. The sensor as claimed in claim 2, further comprising a broadband light source in optical communication with the waveguide for providing an optical spectrum from which the resonance wavelength shift and the reference resonance wavelength shift are derived.

15. The sensor as claimed in claim 3, further comprising a waveguide, wherein the sensing micro-ring and the reference micro-ring are in optical communication with the waveguide.

16. The sensor as claimed in claim 15, further comprising a broadband light source in optical communication with the waveguide for providing an optical spectrum from which the resonance wavelength shift and the reference resonance wavelength shift are derived.

17. The sensor as claimed in claim 5, further comprising a substrate, wherein the sensing micro-ring and the waveguide are fixedly disposed within the substrate such that the spacing between the sensing micro-ring and the waveguide does not vary when force is applied to the diaphragm.