CLAIMS

1. A photonic displacement sensor, comprising:

a photonic fiber including:

a core section having a first band gap aligned along an extended longitudinal axis;

a cladding section surrounding the core section having a second band gap; and

a plurality of fluorophores embedded within the cladding section;

in which the first band gap is adapted to block a spectral band of radiation centered on a first wavelength that is directed along the longitudinal axis, and the second band gap is adapted to block a spectral band of radiation centered on a second wavelength that is directed transversely to the longitudinal axis, and

in which displacement is detected based on a shift in at least one of the first and second band gap of the photonic fiber, enabling an intensity of radiation to be detected that is in proportion to the displacement in the photonic fiber.

2. A photonic displacement sensor according to Claim 1, in which the core section comprises a Fiber Bragg grating and the cladding section is composed of photonic crystal fiber.

3. A photonic displacement sensor according to Claim 1, further comprising a collection fiber positioned adjacent to the cladding of the photonic fiber so as to receive radiation leaked through the cladding.

4. A photonic displacement sensor according to Claim 1, further comprising a second photonic fiber including a core section having a third band gap and a cladding section surrounding the core section, in which the first photonic fiber is adapted to sense tension and the second photonic fiber is adapted to sense compression or vice versa.

5. A photonic displacement sensor according to Claim 4, further comprising a collection fiber positioned adjacent to the cladding of the photonic fiber so as to receive radiation leaked through at least one of the first photonic fiber and the second photonic fiber.

6. A photonic displacement sensor according to Claim 1, further comprising a plurality of fluorophores positioned in the core section, the plurality of fluorophores having an emission wavelength that overlaps the first band gap.

7. A photonic displacement sensor according to Claim 6, in which the plurality of fluorophores include fluorophores of a first type and fluorophores of a second type, the fluorophores of the second type being excitable by emissions of fluorophores of the first type.

8. A photonic displacement sensor according to Claim 7, in which the first type of fluorophore has an emission wavelength slightly shorter that the first band gap of the core and the second type of fluorophore has an emission wavelength slightly longer than the first band gap of the core.

9. A photonic displacement sensor according to Claim 7, in which the fluorophores of the first type include Thulium (Tm^{+3}) ions and the fluorophores of the second type include Dysprosium (Dy^{+3}) ions.

10. A photonic displacement sensor according to Claim 1, further comprising a second core section within the cladding, the second core section having a third band gap different from the first band gap of the first core section.

11. A photonic displacement sensor according to Claim 10, further comprising a plurality of fluorophores positioned in the cladding section.

12. A photonic displacement sensor according to Claim 10, further comprising a collection fiber positioned adjacent to the cladding so as to receive radiation the cladding.

13. A photonic displacement sensor according to Claim 12, in which the collection fiber includes a plurality of fluorophores.

14. A method of determining displacement in a structure, comprising:

providing a photonic sensor, the photonic sensor being embedded in the structure and comprising a photonic fiber having a core section with a first band gap aligned along an extended longitudinal axis and a cladding section surrounding the core section with a second band gap, in which the first band gap is adapted to block a spectral band of

radiation centered on a first wavelength that is directed along the longitudinal axis, the second band gap is adapted to block a spectral band of radiation centered on a second wavelength that is directed transversely to the longitudinal axis, and the cladding comprises fluorophores embedded therein; and

transmitting inspection radiation of a wavelength tuned near the first band gap through the photonic fiber; and

determining displacement within the structure according to an amount of radiation detected through at least one of the core section and the cladding.

15. A method according to Claim 14, further comprising:

positioning a collection fiber adjacent to the cladding of the photonic fiber; and

monitoring radiation at an output of the collection fiber.

16. A method according to Claim 15, further comprising:

embedding a second photonic fiber within the structure, the second photonic fiber having a core section with a third bad gap different from the first band gap; and

determining whether a displacement is a compression or extension according to a wavelength of radiation detected at the output of the collection fiber.

17. A method according to Claim 15, in which the monitoring is performed remotely from the photonic sensor.

18. A method according to Claim 14, further comprising embedding fluorophores of first and second types within the core section, the fluorophores of the second type being excitable by emissions of the fluorophores of the first type.

19. A method according to Claim 14, in which the core section comprises a Fiber Bragg grating and the cladding section is composed of photonic crystal fiber.

20. A method according to Claim 14, in which when displacement does not occur, radiation of a first wavelength propagates through the core and excites fluorophores that emit a second wavelength which can be detected,

in which when longitudinal displacement occurs, the first wavelength is blocked in the core and the fluorophores in the cladding are not be excited and therefore the second wavelength is not detected, and

in which when transverse displacement occurs, the second band gap is shifted, and the transverse displacement is detected based on the shift of the second band gap.