Photonic crystal spectrometer

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Compact two-dimensional photonic crystal spectrometer: Traditional bench top spectrometer applications typically require high spectral sensitivity and low noise. However, emerging spectrometer applications require better portability, smaller size, and lower cost; for example in distributed sensing systems. While conventional diffraction-grating based spectrometers are optimal for achieving high spectral sensitivity, they are less well suited for miniaturization; currently the technology has been developed to the point where further miniaturization and cost reduction appears unlikely. In contrast, the photonic crystal spectrometer does not use diffractive grating optics, allowing significantly decreased size and reduced cost.

Spectrometer uses a compact two-dimensional photonic crystal: The spectrometer uses a compact two-dimensional photonic crystal (PhC) fabricated on top of a planar waveguide structure. The outcoupling of light traveling through the waveguide is wavelength dependent as determined by the lattice spacing of the PhC. Accordingly, the PhC is divided into array elements having different lattice spacing thus creating a spatially resolved map of wavelength bands, which can be easily recorded using a (2 D) image sensor.

The overall cost of the device may be low: no expensive diffraction optics, mass-manufactured image sensors (such as cell-phone cameras), and high-throughput, low-cost manufacturing process like nano-imprint lithography (NIL) for making the PhC. By current estimates, the PhC spectrometer can be more than an order of magnitude cheaper than the cheapest available diffraction-grating based solution in the market today. Add to that the fact that the PhC spectrometer will have a volume of less than 1 cm³, and it is clear that many exciting applications are possible with this spectrometer. Various applications are presently under evaluation; for example, an early prototype was demonstrated to accurately measure the spectrum of a white LED and to determine its color rendering index (CRI).

Applications: • Portable detection and diagnosis, high-resolution distributed sensing and monitoring. • Solid state lighting characterization and testing. • Emissions control and monitoring. • On-line process monitoring and manufacturing quality control.

Advantages: • Overlapping response functions allow for the calculation of broadband spectra using a modest number of array elements. • Low cost due to compact size, use of mass-manufactured image sensors, and simple fabrication technology for making the PhC. • Compatibility with existing applications.

Patent Status: Patent Pending

Licensing Status: Available for Licensing and Sponsored Research Support

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