Detecting Change of Dielectric Constant

A method for detecting materials by using a ring resonator

Georgia Tech inventors have developed a method for detecting materials by using a ring resonator. The change in the power of the electromagnetic wave in the circular resonator which is in contact with the selected material enables the sensing function to occur and the material detection to take The apparatus developed consists of input and output waveguides in close proximity to the circular resonator. The resonator is bonded to a material that needs to be identified or detected. This bonding causes a change in the effective dielectric constant of the resonator and in turn changes the electromagnetic wave intensity within the resonator. The change in intensity of the electromagnetic wave is detected by the output waveguide and this determines qualitative and quantitative aspects of the material to be detected.

Summary Bullets

- Enables detection of materials based on changes to the effective dielectric constant of a circular resonator
- Measures the index of refraction to detect the change in optical wavelength that is occurring
- Able to detect the power of the electromagnetic wave in the circular resonator at resonance condition and/or during build-up stage

Solution Advantages

- Enables detection of materials based on changes to the effective dielectric constant of a circular resonator
- Measures the index of refraction to detect the change in optical wavelength that is occurring
- Able to detect the power of the electromagnetic wave in the circular resonator at resonance condition and/or during build-up stage
- Qualitative and quantitative detection of the selected material is enabled when used as a sensor

Potential Commercial Applications

- Gas and chemical substance sensing
- Room air monitoring for energy-efficient control of air conditioning systems
- Calorific value determination
- Hazardous substance detection

Background and More Information

A ring resonator typically consists of an optical waveguide in a circular (loop) format which resonates when the loop wavelength equals a whole number of wavelengths of an injected electromagnetic wave. Ring resonators are frequently used to select an appropriate electromagnetic wavelength for various applications such as sensing chemical substances or bio-agents. Applications that use ring resonators as standalone devices require that the resonator have a coupling with the outside world such as another waveguide allowing the ring resonator to behave as a filter when an electromagnetic wave is transmitted through the waveguide.

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Publications

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