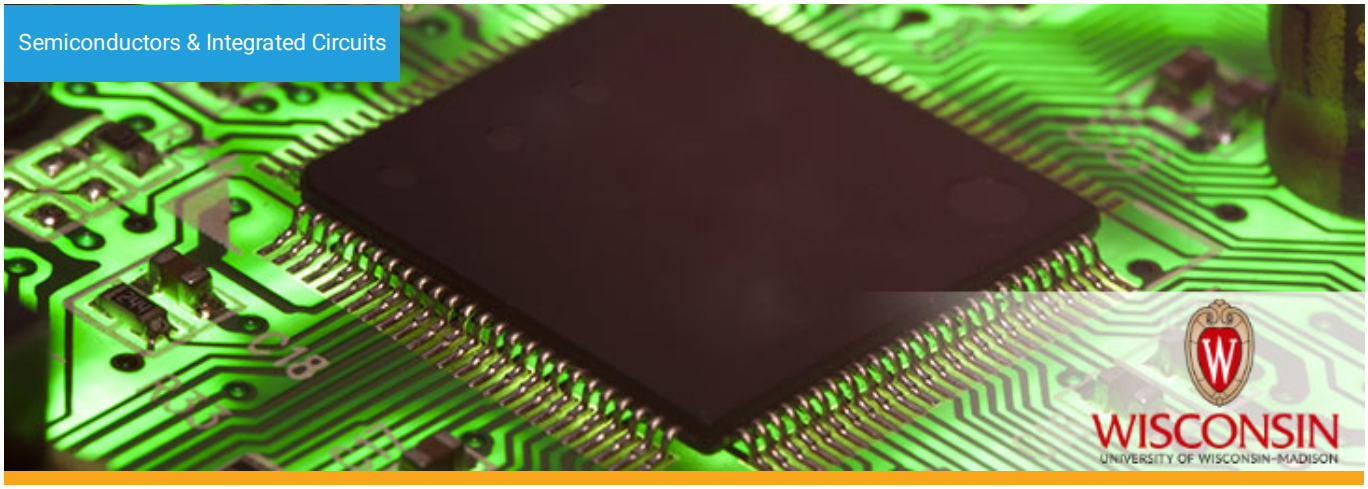

Tuning Optical Microcavities

View U.S. Patent No. 9,223,156 in PDF format.

WARF: P140153US01

Inventors: Randall Goldsmith, Kevin Heylman

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method for tuning the resonance frequencies of ultrahigh-quality factor toroidal optical microcavities.

Overview

A whispering gallery mode (WGM) is a type of electromagnetic wave that travels around a concave surface. Such waves can propagate at the edge of a very small structure called an optical microcavity. WGM microcavities are rich experimental platforms for quantum optics, photonics and sensing applications.

A microcavity may be characterized by its resonance frequencies, i.e., those frequencies at which light is most strongly coupled into the microcavity, as well as by its quality factor (Q). The structure may take a variety of shapes like a sphere, disk or toroid. Ultrahigh-Q toroidal optical microcavities are particularly suited for nonlinear optics and detection of single particles.

For many experiments it is important to control the absolute resonance position of the microcavity. The new strategy being developed by UW–Madison researchers is to use a laser to heat the microcavity without adding cost and complexity to the fabrication process.

The Invention

The researchers have developed a tuning method for ultrahigh-Q toroidal optical microcavities capable of rapid modulation and resonance position control.

In the new configuration, a free-space pump laser beam illuminates the pillar supporting the microcavity, which warms ups and transfers heat to the microcavity. This induces a shift in resonance frequency. The support pillar is made of silicon or other suitable material.

The intensity of the free-space laser beam can be adjusted by changing the power and/or focal spot of the beam. Different intensities are used to achieve the desired shift in resonance frequency.

Applications

- Microscopy and single molecule measurements
- Optical processing, e.g., switching

Key Benefits

- Highly versatile method
- Allows control of the optical properties of ultrahigh-Q microcavities with unprecedented sensitivity, range and speed
- Method can reproducibly shift resonance by a few to more than 10,000 times the full width at half maximum (FWHM).

Stage of Development

Improvements in resonance, power absorption and frequency response have been experimentally demonstrated using multiple silicon toroids.

Additional Information

For More Information About the Inventors

- Randall Goldsmith

Publications

- Heylman K.D. and Goldsmith R.H. 2013. Photothermal Mapping and Free-Space Laser Tuning of Toroidal Optical Microcavities. Appl. Phys. Lett. 103, 211116.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Microscopy
- Semiconductors & Integrated Circuits : Other semiconductor technologies

For current licensing status, please contact Mark Staudt at mstaudt@warf.org or 608-960-9845