Enhanced Quantum Spin-sensing Using Light Trapping in a Massively Multimode Diamond Resonator
Technology #16809

Applications

- Thermometry
- Magnetometry
- Electric field sensing
- Inertial sensing
- Timekeeping

Problem Addressed

A nitrogen vacancy is a point defect in a diamond. Point defects have the special property that the diamond is very responsive to changes in the external environment at these locations. For example, changes in a magnetic field around a diamond can be detected through careful observation of the spin state of the diamond at the nitrogen vacancy. In addition, observing an ensemble of nitrogen vacancies can enhance the sensitivity of a diamond’s detection potential. However, methods are needed for amplifying the signal generated by a diamond to facilitate the sensing process.

Technology

The invention is a room temperature bulk diamond sensor on a massively multimode resonate design. The invention includes a method for enhancing the signal generated from bulk diamond plates. First, an ensemble of diamonds with nitrogen vacancies are prepared. Second, laser light is trapped within the diamonds. The light will interact with the nitrogen vacancies, which will alter the trajectory of the beams. A fraction of the light will eventually escape. The location and intensity of the emitted light is reflective of the spin state of the diamond at the nitrogen vacancies. Thus, quantum spin-sensing measurements can be measured by careful observation of the emitted light. Finally, as the spin state is sensitive to changes in the environment, such as temperature and magnetic field strength, this system is a highly sensitive bulk diamond sensor.

Advantages

- Very sensitive magnetometer with minimal shot-noise
- Room temperature sensing
- Portable and miniaturizable

Categories For This Invention:

- Materials
- Photonics
- Sensors (Photonics)
- Detectors
**Intellectual Property:**
Methods and apparatus for optically detecting magnetic resonance
Issued US Patent
Methods and apparatus for optically detecting magnetic resonance
US Patent Pending
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**Publications:**
Broadband Magnetometry and Temperature Sensing with a Light-trapping Diamond Waveguide
Nature Physics
April 6, 2015
Better Sensors for Medical Imaging, Contraband Detection
MIT News
April 6, 2015

**External Links:**
Quantum Photonics Laboratory
http://www.rle.mit.edu/qp/

**Image Gallery:**

![Image 1]
![Image 2]