NISTTech

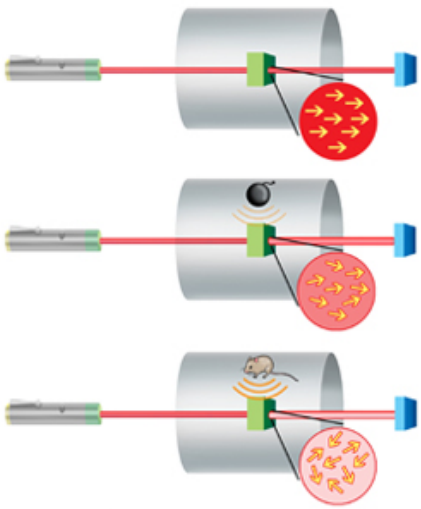
AN ATOMIC MAGNETOMETER AND METHOD OF SENSING MAGNETIC FIELDS

Optical, precise sensing of magnetic fields for physiological and environmental applications

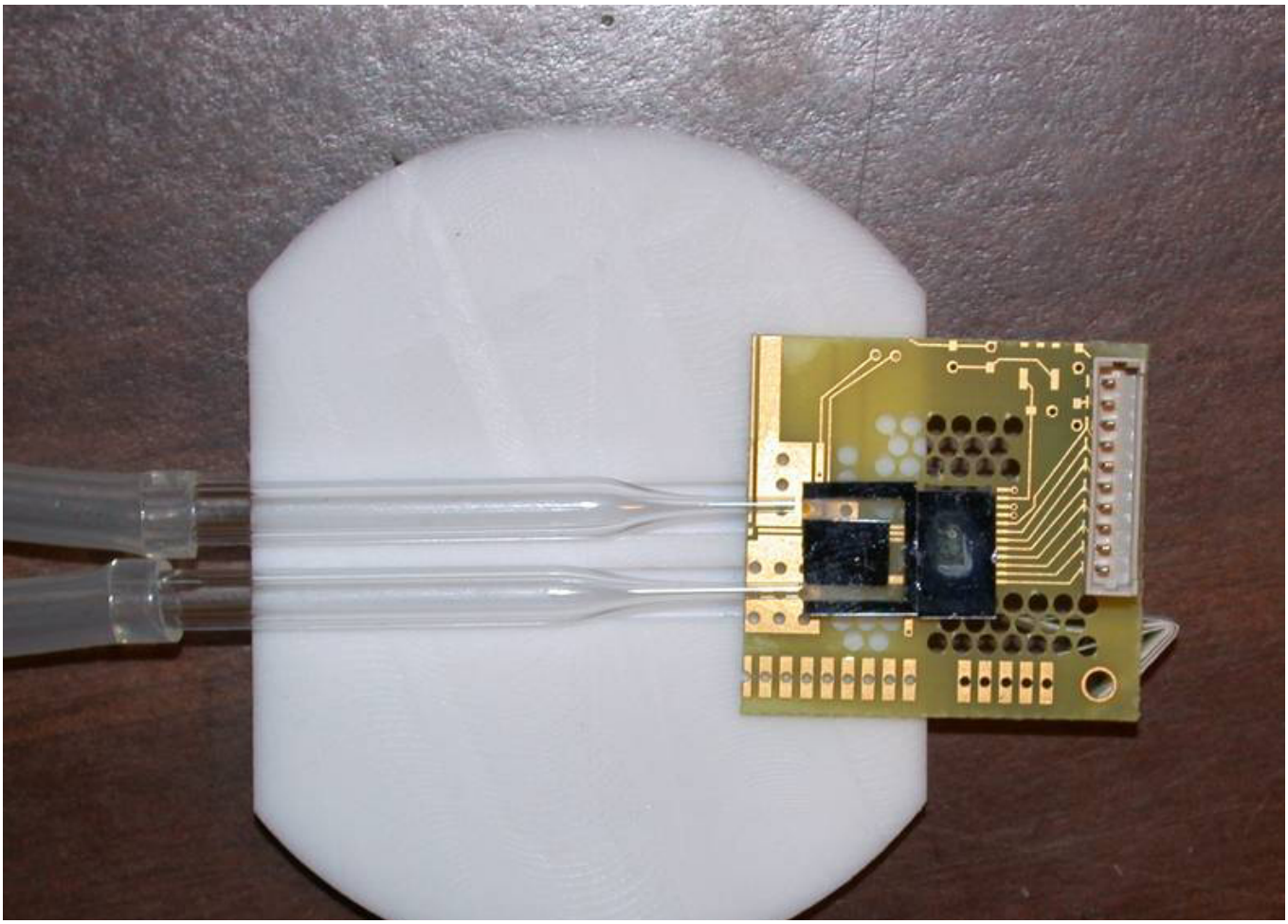
Description

This miniature, fiber-coupled sensor head enables highly precise, remote sensing of electromagnetic fields and possibly other environmental parameters of interest. The sensor is based on a small alkali vapor cell, suspended in an enclosure by a low thermal conductivity material. The cell is heated to its operating temperature with a laser beam, delivered to the cell either through one or more optical fibers or through free space. The sensor signal is monitored by illuminating the cell with a second light beam, which is transmitted through the vapor and reflected back towards the measurer, either through another optical fiber or through free space.

Images



Laser light passes through atoms in a gas. When no sample is present, all light passes to the detector. In the presence of a magnetic field, less light reaches the detector. Credit: Loel Barr.



Prototype microchip device combining NIST's miniature atomic magnetometer with a fluid channel for studies of tiny samples. Credit: NIST

Applications

- **Environmental**
  Permits remote sensing of electromagnetic fields to aid in geophysical mapping, navigation, underground deposit detection (underground objects)
- **Medical Research and Clinical Diagnosis**
  Enables physiological mapping by sensing magnetic fields within living organism (heart and brain) providing richer content without requiring electrodes
- **Homeland Safety**
  Applicable in airport screening for explosives containing nitrogen compounds

Advantages

- **All optical**
  All optical signals to and from the sensor head, heating of vapor cell, temperature stabilization, and interrogation of the atomic resonances
- **At least one sensor head free of electrical contacts, pathways and magnetic fields**
  Sensor head free of metallic components, electrical contacts so there is no electrically conducting path between the sensor head and the instrumentation box, and no magnetic fields are applied at sensor location
- **Adaptable and sensitive**
  Easily adapted to sensor array applications; sub-pT sensitivities are possible; self-alignment of components possible
- **Performs in ambient temperatures**
  No cryogenics needed

Abstract

A magnetometer and method of use is presently disclosed. The magnetometer has at least one sensor void of extraneous metallic components, electrical contacts and electrically conducting pathways. The sensor contains an active material vapor, such as an alkali vapor, that alters at least one measurable parameter of light passing there through, when in a magnetic field. The sensor may have an absorptive material configured to absorb laser light and thereby activate or heat the active material vapor.

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Citations

1. NIST Docket 08-017, Integrated Microchip Incorporating Atomic Magnetometers and Microfluidic Channels for Detection of NMR and MRI

Related Items

- Article: Mini Magnetic Sensor May Have Biomedical, Security Applications
- Atomic Devices and Instrumentation Group
- Article: 'NMR on a Chip' Features NIST Magnetic Mini-Sensor

References

- U.S. Patent Application #20110031969; Serial #12/537,922; Expires on 5/6/2031
- Docket: 08-018

Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

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