Magneto-Optic Fiber Bragg Grating

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SUMMARY

Professor Greg Carman of the UCLA Department of Mechanical and Aerospace Engineering and colleagues at NASA's Armstrong Flight Research Center have developed a method to couple multiferroic and optical behaviors in fiber Bragg gratings to detect minute changes in temperature or magnetic fields.

BACKGROUND

The past decade has seen the development of optical fiber Bragg grating (FBG) sensors to measure physical quantities such as temperature, strain, and pressure. The high precision of this general approach has led to many field-coupled coatings being developed to create entirely new sensor systems. To illustrate, a palladium-coated FBG robustly senses hydrogen, which can be used for alternative energy applications.

However, a more significant unmet need is a FBG coating that detects minute changes in temperature and magnetic fields. Current FBG-based methods for this application detect external fields via strain, Faraday-effect materials, or ferrofluids. But, this additional step introduces extraneous thermal and mechanical influences. An invention that bypasses this would be a strong candidate for integration into sensing systems used a variety of industries, including homeland security, navigation, and mineral exploration.

INNOVATION

The inventors have developed a method to couple multiferroic and optical behaviors in fiber Bragg gratings. By directly coupling the external field to the electromagnetic wave propagating in the FBG-containing fiber, the invention significantly improves on the current state of the art, offering greater sensitivity, compactness, and signal resolution.

APPLICATIONS

- Military/security: detection of explosive devices
- Navigation: backup for satellite GPS, altitude sensing
- Mineral exploration
- Geophysical surveys
- Oil and gas drilling
- Use as an optical switch or selective filter activated by a known magnetic field

ADVANTAGES

- Readily integrated into optical circuits that cannot accommodate bulk field-coupling actuators
- Lighter and more compact than conventional EM field devices
- Direct coupling between external field and EM wave reduces extraneous thermal and mechanical influences

STATE OF DEVELOPMENT

The invention has been successfully fabricated and characterized over a relevant temperature range.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,274,181	03/01/2016	2012-060

CONTACT

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OTHER INFORMATION

KEYWORDS

Bragg, sensor, magnetic field, temperature field, detection, optics

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Communications**
  - Optical
- **Environment**
  - Other
- **Security and Defense**
  - Other
- **Sensors & Instrumentation**
  - Other
- **Engineering**
  - Other

RELATED CASES

2012-060-0

RELATED MATERIALS

- Mohanchandra KP, Karnani S, Emmons MC, Richards WL, and Carman GP. Thin film NiTi coatings on optical fiber Bragg sensors, Applied Physics Letters, 2008, 93 (3).
- Emmons MC, Kim HKD, Carman GP, and Richards WL. Magneto-optic field coupling in optical fiber Bragg gratings. Optical Fiber Technology, 2012, 18 (3).

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- A Multiferroic Transducer For Audio Applications
- Bidirectional Hyperelastic Covers for Woven Stents

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