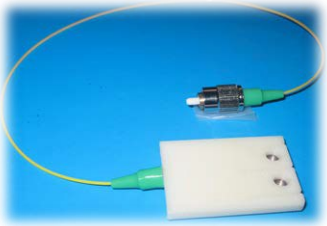
TECHNOLOGY SUMMARY

Dual-parameter fiber optic sensor



Reference

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Patent status

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Stage of development

Working prototype developed and tested

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Background

In many situations it is imperative to collect distributed measurements of temperature and loading strains transduced by pressure, direct force, etc. in bridges for structural heath monitoring, conventional and unconventional oil/gas wells (e.g. steam-assisted gravity drainage), for detecting gas leakage due to geo-mechanical effects, for monitoring structural components in airplanes, for monitoring down-hole seismic wave effects in underwater reservoirs, and many more applications. Currently the only way to obtain these parameters is to monitor a series of different sensors for each parameter. These multiple sensors each require their own monitoring equipment (e.g. interrogator electronics, packaging, etc.) and as a result are costly. A single sensor capable of simultaneously measuring temperature and pressure would be much more cost effective enabling broader use and applications of fiber optic sensor technology.

Description of the invention

Waterloo researchers have created an opto-mechanical sensor, known as Dual-parameter optical sensor, capable of simultaneously detecting thermal and loading strains. The fiber optic sensor utilizes a special on-fiber thin metallic coating of a fiber Bragg grating (FBG) that enables this simultaneous multiple measurement capability. Several sensor packaging designs have also been developed for various applications and successfully tested with the dual-parameter optical sensors with the following performance specifications:

- Sensitivity to pressure: 6.01 pm/bar
- Sensitivity to axial force: 3.79 nm/newton
- Sensitivity to temperature: 26.10 pm/°C

To date, packaged prototype sensors have been tested up to 2000 µStrain at 220 bars and temperature from 20°C to 120°C. However, the sensor has the capability to be adjusted/packaged for measuring up to 4000 µStrain and temperatures ranging from -40°C to 300°C.

Advantages

- Measuring temperature and pressure at one physical location.
- Simplicity.
- One end attachment to the light source and interrogator.
- Distributed measurements (e.g. up to 80 sensors in one string of the fiber in kilometer-length).
- Immune to magnetic field.
- Lightweight and small in size (e.g. packaged in a ¼" size pipe).

Potential applications

- Unconventional oil/gas wells (i.e. SAGD).
- Conventional shale oil/gas wells.
- Structural health monitoring (e.g. bridges, roads, etc.).
- Medical (e.g. in-vitro/in-vivo studies and esophageal waves).
- Strain/temperature measurements in any engineering system (e.g. airplane wings, fuselage, drilling tools).