Submission for SPIE Optics+Photonics Conference, Aug. 10-14, 2008, San Diego

TITLE

Fiber-optic current sensors based on polarization coherence and power scattering in magneto-optical films

AUTHORS

Alan Hsu, Alex Robinson, Richard Cernosek

ABSTRACT for Online Submission (100 words)

Fiber-optic sensors for sensing electrical current are attractive due to their inherent immunity to electromagnetic interference. Several groups have shown the use of Faraday rotation in magneto-optical materials as a function of current-induced magnetic field. In this work, fiber-optic sensors based on different mechanisms such as magnetic-field-dependent polarization coherence and power scattering effects in magneto-optical materials are demonstrated. These novel sensor configurations can have advantages in that they exhibit power-independent or polarization-independent operation which can ultimately lead to fewer components and relaxed light source requirements compared to fiber-optic current sensor systems based on Faraday rotation. (95 words)

ABSTRACT for Technical Review (250 words)

Fiber-optic sensors for sensing electrical current are attractive due to their inherent immunity to electromagnetic interference. Several groups have shown the use of Faraday rotation in magneto-optical materials as a function of current-induced magnetic field. In this work, fiber-optic sensors based on different mechanisms such as magnetic-field-dependent scattering effects and polarization coherence effects in magneto-optical materials are demonstrated. These novel sensor configurations can have advantages in that they exhibit power-independent or polarization-independent operation which can ultimately lead to fewer components and relaxed light source requirements compared to fiber-optic current sensor systems based on Faraday rotation.

Fiber-optic current sensors in reflective-geometry configurations based on bismuth-doped rare-earth iron garnet (BIG) films are investigated. As an external magnetic field is increased from 0 to 700G, several interesting effects are observed. In addition to Faraday rotation, the light power transmission at 1550nm through the BIG film increases by over 100%. Also, the degree of polarization (DOP) increases from 3% from a largely depolarized broadband source at 0G to about 40% at 600G. When the highly-polarized laser source is used, similar increases in power and DOP are observed with increasing magnetic field. These increases in power and DOP as a function of magnetic field are also relatively independent of the specific input power, DOP and polarization direction of the input light signal. Fiber-optic systems of this type would therefore not require polarizers or light sources that are of a specific DOP or polarization direction and could make use of less power-consumptive laser sources. (248 words)