UC07

An Opto-Mechatronic Magnetic Field Microsensor

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An opto-mechatronic microsensor for sensing magnetic field strength is designed, fabricated and tested. It is fabricated using low temperature silicon-based MEMS compatible technologies. Current driven coils on a flexible polyimide membrane are established to serve as the measurement and calibration pattern. The membrane movement is accomplished by the Lorentz force acting on the supplied current. A Ni thin film is deposited on the centre of membrane that is driven by magnetic actuation to enhance sensitivity. To overcome measurement problems caused by the mechanically pre-stressed deformation, a current excitation is used for the sensor characterization. The membrane deformation is monitored using a precision optical displacement measurement system. By means of ac excitation of the membrane, pre-stressed condition can also be used for measurement. The schematic view of the magnetic microsensor with measurement blocks is shown in Fig.1. Results show that the proposed microsesor shows good magnetic measurement behaviours. A measurement rang of the magnetic strength of 2.2 T was achieved by evaluating the Bragg wavelength shift using Nd-Fe-B magnets. Further development of improvements in microsensor's immunity to thermal and mechanical perturbations would improve measurement stability and sensitivity.

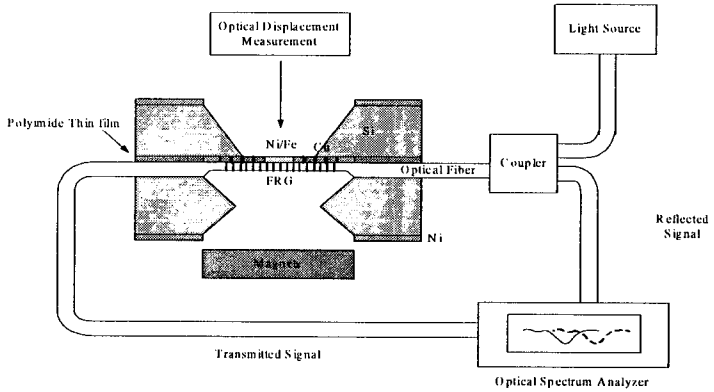

Fig. 1. Schematic drawing of the opto-mechatronic microsensor with measurement blocks.

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UC08

Measurement of ac current using a optical fiber sensor

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In the power industry, current must be measured for metering and protection purposes. For such measurements, we have demonstrated an optical fiber sensor using a single fiber Bragg grating (FBG) for measuring ac current in this paper. The sensor head is based on FBG encapsulated in a polymer-half-field metal cylinder embedded a magnetic material at measure point with the characteristics of all-optical high pressure sensitivity. The operating mechanism is that the sensor can be attracted by the induced magnetic force created by the solenoid along one radial direction only, and responds to an axial force on the magnetic rod attached to the round plate, creating an axial attraction on the FBG. Fig. 1 shows the device of ac current measurement. The ac current is detected by current transformer (CT) for scaling down the large current of power line. The peak value of the current is measured through the peak detector circuit consisted by diode and capacitor. The sensing mechanism in this device is based on the radial magnetic force that is induced by the solenoid for different currents. The magnetic force will stretch the fiber to cause the Bragg wavelength shift. The magnetic force in the solenoid is attracted by the magnetic rod on the end of the FBG and cause the change of the effective refraction index. The amount of the Bragg wavelength shift is proportional to the radial magnetic force. From measuring the amount of Bragg wavelength shift by using an optical spectrum analyzer (OSA), the magnetic field strength can be determined. Since the magnetic field strength in the solenoid is proportion to the applied current, the magnitude of the peak value of ac current can also be determined. The proposed current sensor consists of a FBG with a magnetic rod at one end. The experimental setup is as shown in Fig. 2. A plot of the measured Bragg wavelength is a function of the current shown in Fig.3, which also displays very good linearity betweenthe Bragg wavelength and the applied current.

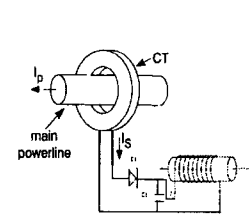

Fig. 1. Device for ac current measurement

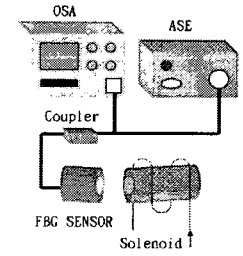

Fig. 2. The experimental setup

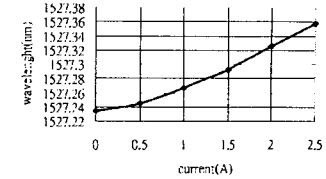

Fig. 3. Measured wavelength is function of the current

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