

Applied Force Micro Bending Fiber Sensor

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ABSTRACT— *Fiber optics sensor technology offers different parameter measurements such as strain, pressure, temperature, current and many more things. A simple, compact, and low-cost optical fiber force sensor is presented. It consists of a laser source at wavelength 650nm, MMF multimode fiber which pass through micro bending cell .The cell is applied force in range 5N to 50N,the output signal is measured by power meter and spectrometer. The applied force on the sensor cause optical fiber deformed, which lead to the loss of output light, so the force can be obtained through measuring the variation of light intensity in optical fiber. Static response experiment shows that the fiber-optic micro bend system has fine linear character to the force in the scope of 5-50N.*

Keywords— Fiber Optics, Fiber optical sensors, micrbend fiber sensor, Force fiber sensor.

1. INTRODUCTION

Microbend loss has always been an undesirable effect that causes problems in fiber-optic communication links. However, this phenomenon has been exploited profitably in the fabrication of a variety of fiber-optic Sensors[1–3] to measure, e.g., pressure, force, temperature, and displacement. Essentially, microbend sensors are based on coupling and leakage of modes that are propagating in a deformed fiber. Usually one achieves this deformation by employing corrugated plates that deform the fiber into a series of sharp bends with small bending radii. Such periodic bending causes coupling of energy among various guided modes as well as between guided modes and leaky modes; the latter causes a loss in transmission. In most cases these bends made in the fiber are temporary inasmuch as the deformations in the fiber will vanish if the force applied to the corrugated plates is removed, provided that the force applied is within the elastic range of the fiber. However, a few investigations have been carried out with permanent microbend fibers also[4,5]. But those studies were essentially an extension of what has been done with temporary microbend fibers and were used mainly for measuring physical parameters. It would be interesting to examine the losses in such a permanently bent fiber when it is subjected to various applied force environmental conditions.

2. EXPERIMENTAL WORK

In the present work the describe of a permanently deformed fiber for the development of a force sensor. We introduce a series of microbends into a plastic multimode step-index fiber at length 60cm and a numerical aperture of 0.3 by sandwiching the fiber with a pair of corrugated plates and applying sufficient force . Schematic diagram of the setup used to deform the optical fiber is shown in fig (1). The pitch of the corrugations λ is the distance between two consecutive deformations, which is 8 mm in the present case.

Conventional microbend sensors work on the principle that, when a fiber is subjected to squeezing between a pair of corrugated plates, a loss of transmitted intensity takes place as a result of mode coupling between guided modes that consist of the core and leaky modes that comprise both cladding modes and radiation modes

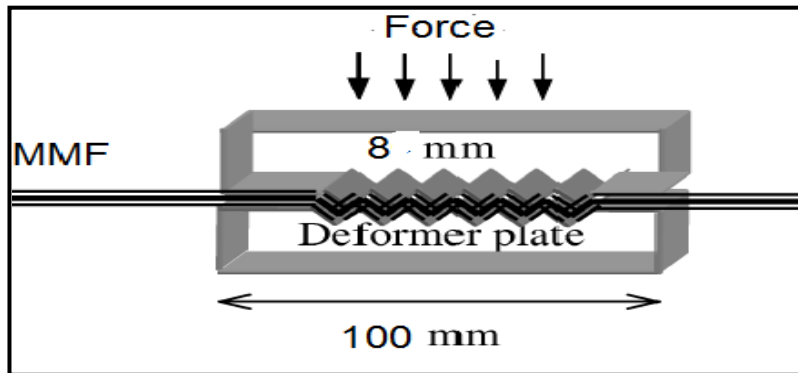


Figure (1) Schematic diagram of the setup used to deform the optical fiber.

The Schematic diagram of experimental setup is shown in fig(2) and the photograph picture is shown in fig(3). The experimental setup consists of: L, diode laser (650 nm, 1mW model FDD 111); C deformer cell; F_s multi mode (125/225) optical fibers; D detector [(Lambda LLM-2 Light power source and spectrometer (Ocean Optics HR 2000)), personal computer to display the intensity spectrum and the applied force instrumentation.

The power meter is used to measure the output power from fiber end and the spectrometer is used to record the spectrum between wavelength versus light intensity at each case of applied force. The force is varied from 5 N to 50 N.

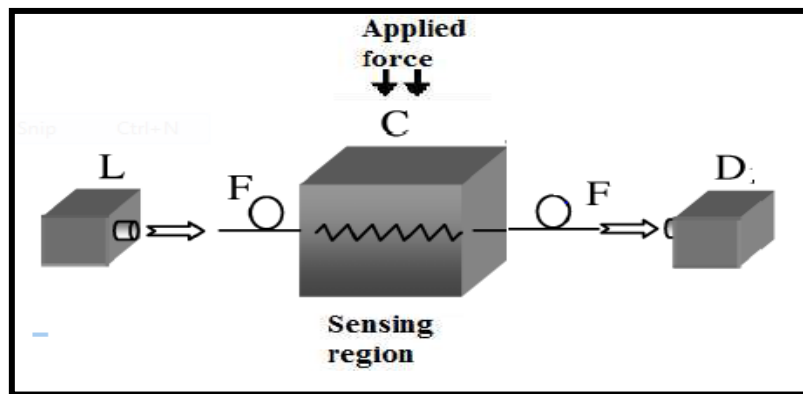


Figure.(2) Schematic diagram of the experimental setup.



Fig(3) The photograph of experimental work.

3. RESULT AND DISCUSSION

Fig(4) shows the variation of output power from 60 cm multimode PCS fiber with various applied force. On the analysis of static experimental data, we can see that fiber-optic sensor response has good linearity from 5 to 50N.

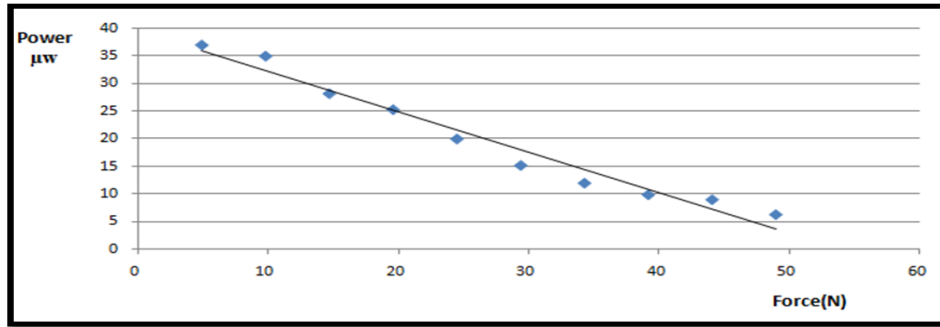


Figure (4) The relation between applied force and the output power.

Microbending causes light coupling from core-guided modes into radiation modes, resulting in irreversible light loss and decreased (modulated) light intensity detected by the transceiver.

Fig(5) shows the Intensity spectrum for versus applied force .From this figure is shown when increase the applied force the peak intensity decrease. The amount of light loss while increasing the force is an important parameter for sensitivity in fiber optic microbend sensors since the magnitude of the measured can be determined by correlating the loss of light intensity.

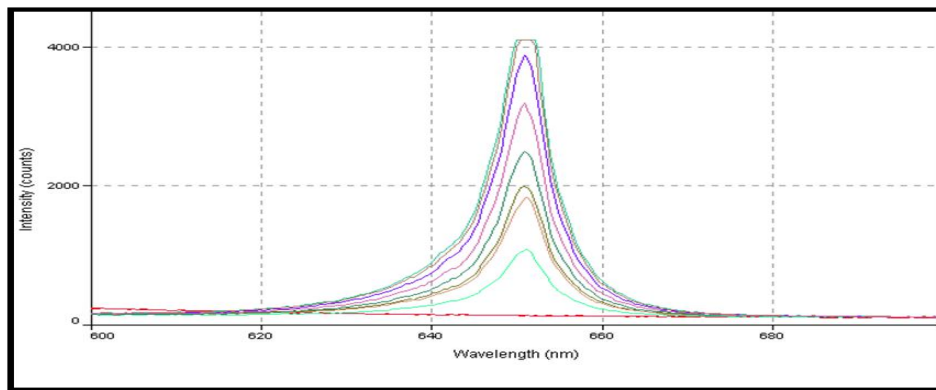


Figure (5) Intensity spectrum for versus applied force .

The relation between the peak of intensity for each applied force is shown in fig (6).

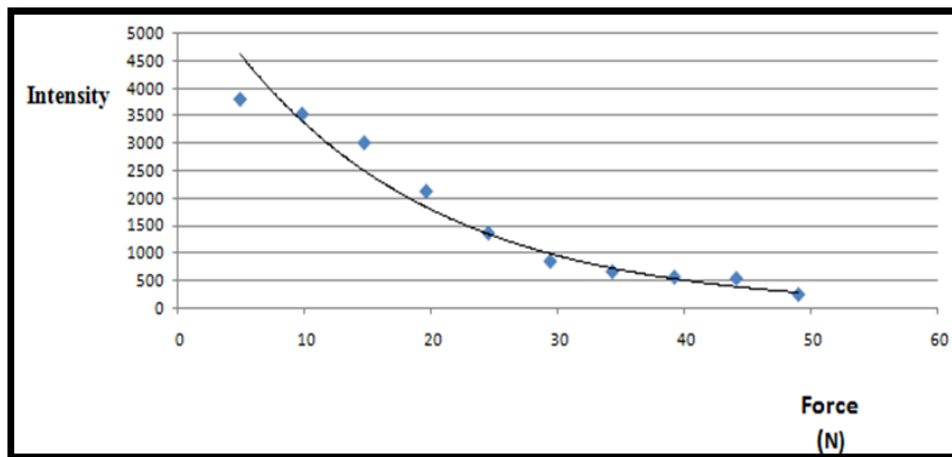


Figure (6) The relation between applied force and the max intensity.

From the fig(6) the intensity is decrease when increase the applied force .The maximum intensity is shown at applied force equal 5 N and the minimum intensity at 50 N.

4. CONCLUSION

Low-cost optical fiber force sensor is presented. It consists of a laser source at wavelength 650nm, multimode fiber which pass through micro bending cell .The cell is applied force in range 5N to 50N, the output signal is measured by power meter and spectrometer. The pressure force on the sensor cause optical fiber deformed, which lead to the loss of output light, so the force can be obtained through measuring the variation of light intensity in optical fiber.

5. REFERENCES

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