

FBG Interrogation using SMS fiber and OTDR for Simultaneous Measurements of Temperature and Strain

Koustav Dey¹, Sourabh Roy^{*1}, B. Ramesh Kumar², M. Sai Shankar¹, P. Kishore¹,

¹National Institute of Technology, Warangal, TS-506 004

²Institute for Plasma Research, Gandhinagar, Gujarat-382428

Email: sroy@nitw.ac.in

1. Introduction

A simple and efficient method of interrogating Fiber Bragg Grating (FBG) sensor signals is proposed here using Single mode-Multimode-Single mode (SMS) fiber device and Optical Time Domain Reflectometer (OTDR). Eventually the sensor signals are analyzed for dual parameter measurement of temperature and strain. The SMS fiber device explored the multimode interference (MMI) which occurs along the length of multimode fiber (MMF) [1]. Alongside the FBG is a wavelength coded sensing device which needs an interrogation system for essential conversion of wavelength information encoded in optical power [2]. Hence combined sensing outputs from the FBG and SMS signals are monitored using OTDR. The obtained results of strain and temperature measurements from this proposed scheme perform better and enhanced sensitivity with respect to existing method [3].

2. Experimental Details

The SMS fiber structure is fabricated using a commercial fusion splicer (Fujikura- 60S) by splicing a multimode fiber (50/125 μm) section between two single mode fibers (9/125 μm). The OTDR (JDSU MTS 8000 series) with an operational wavelength 1545 nm is used to detect the event induced by the temperature changes on the FBG. The OTDR measures the attenuation of reflected light or return loss and the location from where the light is being reflected within 5 km range of optical fiber network with resolution of 0.001 dB. Here, we have investigated the attenuation loss of an FBG of central wavelength 1545 nm using SMS fiber with the help of OTDR. The power loss is measured with variation of temperature and strain separately and also for the variation of temperature at discrete constant load (100 to 500 gms with an increment of 100 gms) in the range of 25°C to 100°C. As the FBG peak follows the linear slope region of SMS, it is expected that the response of OTDR also to be linear which is confirmed from the obtained results, that showing good linearity with adjustable $R^2 = 0.98$. Our scheme of interrogation is expected to be robust, cheap and more efficient for simultaneous measurement of temperature and strain with good sensitivity.

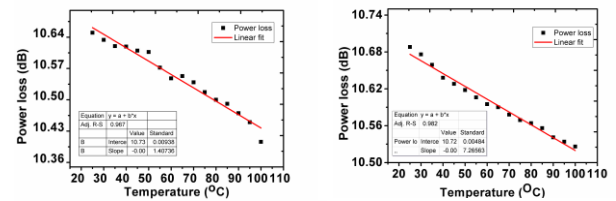


Fig.1 (a).Temp.vs Power loss (b). Temp.vs Power loss at const. loads

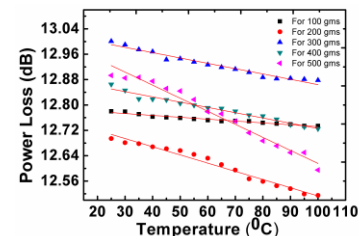


Fig.2. Comparison between power loss vs temp. at different loads

3. Conclusions

1. As the FBG peak follows the linear slope region of SMS, it is expected that the response of the OTDR also to be linear which is confirmed from the obtained results, that showing good linearity with adjustable $R^2=0.98$

2. The obtained results of strain & temperature measurements from this proposed scheme perform better and enhanced sensitivity with respect to existing method

Acknowledgements

The author is highly grateful to BRNS (RS-872-Gol-BRNS-(DAE)-SR-PHYSICS(2017-18)) For their funding's.

References

- [1]. P.S.Reddy, Photonic sensor, **2**, (2012) 203-214.
- [2]. Q.Wu, Optics express, **19**, (2012) 7937-7944.
- [3]. A.M.Hatta, Photonic sensors, **3**, (2013) 262-266.