Interrogation of SMS for measuring of temperature and strain using half-etched FBG

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1. Introduction

Fiber Bragg Grating (FBG) based optical sensing has been intensively investigated owing to its potential for measurement of several physical parameter like temperature, strain, pressure etc. FBG is a wavelength coded sensing device which needs an interrogation technique for essential conversion of optical power to wavelength information [1]. Multimode interference (MMI) effect of single-mode-multimode-single-mode (SMS) fiber has employed for this interrogation technique [2]. The combining sensing outputs from FBG and SMS signals are monitored using optical spectrum analyzer (OSA).

Here we have demonstrated a novel sensing configuration for simultaneous measurement of strain and temperature with enhanced intrinsic sensitivity based on half-etched FBG interrogated with the SMS.

2. Experimental Details

The SMS fiber structure is fabricated using a commercial fusion splicer (Fujikura- 60S). A multimode fiber (50/125 µm) section is sandwiched between two step index single mode fibers (9/125 µm) axially. The FBG inscribed on an optical fiber is half etched using 40% hydrofluoric acid solution to reach an optimized cladding diameter of 60µm. For temperature sensing we kept the half etched FBG inside an oven which is again connected to a dimmer stat for controlling the temperature. For strain sensing, we pasted the FBG on a cantilever using high temperature instant adhesive. Here we have investigated the power loss and wavelength shift of FBG of central wavelength of 1523nm which lies in the ripple free slope region of SMS i.e., 1519nm-1227nm. The power loss and wavelength shift has measured for variation of temperature and strain in the range of 25ºC to 200ºC and 100µε to 2015µε respectively. As the FBG peak is following the linear slope region so it is expected that the response also to be linear which can be confirmed from obtained results, showing good linearity of ~0.999. We have achieved temperature sensitivity ~19.1pm/ºC which is 4 times greater than the interrogation technique using un-etched FBG [3].

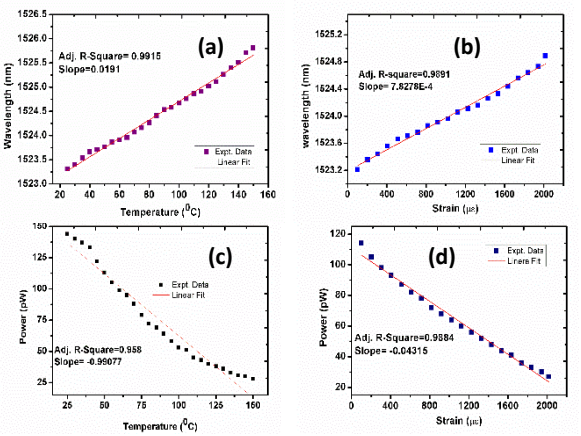

Fig. 1 (a) & (b) temperature and strain vs. wavelength Shift; and (c) & (d) temperature and strain vs. power loss respectively.

3. Conclusions

In conclusion, we have reported an experimental study of a sensing configuration for measuring temperature and strain with enhanced sensitivity using half etched FBG. As the FBG peak follows the linear slope region of SMS, it is expected that the response of the OSA also to be linear which is confirmed from the obtained results, that showing good linearity with adjustable R^2=0.99. Achieved sensitivity of 19.1pm/ºC, is four times greater than un-etched FBG confirms the enhancement of sensitivity using half etched FBG. The sensor has experimentally demonstrated temperature and strain sensitivity of 19.1pm/ºC and 0.7pm/µε respectively.

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