

Fibre-optic interferometric pressure sensor based on droplet-shaped PDMS elastomer

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A range of single-mode fibre-optic based on reflective Fabry-Perot (F-P) interferometer have been developed in the past two decades for the detection and measurement of various physical, chemical and biomedical parameters[1]. It is considered as the most convenient configuration as it is simply based on the optical cavity where beam interference occurs and is formed by two parallel mirrors.

In this work, we present a low pressure sensor based on white-light Fabry-Perot interferometer where poly-dimethylsiloxane (PDMS) elastomer is defined as the F-P optical cavity. An erbium-doped fibre amplifier (EDFA) has been used as low-coherent white-light source transmitted through a single-mode fibre (SMF-28). The light is coupled from a 50:50 four-port 3-dB coupler and is splitted in two ends. One of the outputs is connected to the sensing element (PDMS elastomer) while index-matching liquid has been used to eliminate the reflections from the extra end. Finally, an optical spectrum analyser (ANDO AQ-6310B) and a computer are connected in order to measure and analyse the reflected spectrum. The experimental set-up is illustrated in Figure 1 (a).

The sensing element of our system is based on PDMS elastomer due to ability to provide low young's modulus (~1.8 MPa). Furthermore, PDMS is optically clear, and is generally considered to be biocompatible, non-toxic and low-cost silicone [2]. The F-P cavity of the sensing probe is formed by two reflecting mirrors (M1, M2) separated at distance d , as shown in Figure 1 (b). The deformation of the elastomer induced by the pressure varies the cavity length. The cavity length d , corresponding to applied pressure can be determined by measuring the spectrum of reflection light of the sensor. Conversion of the cavity deformation to pressure [3], can finally provide the performance of the sensor system.

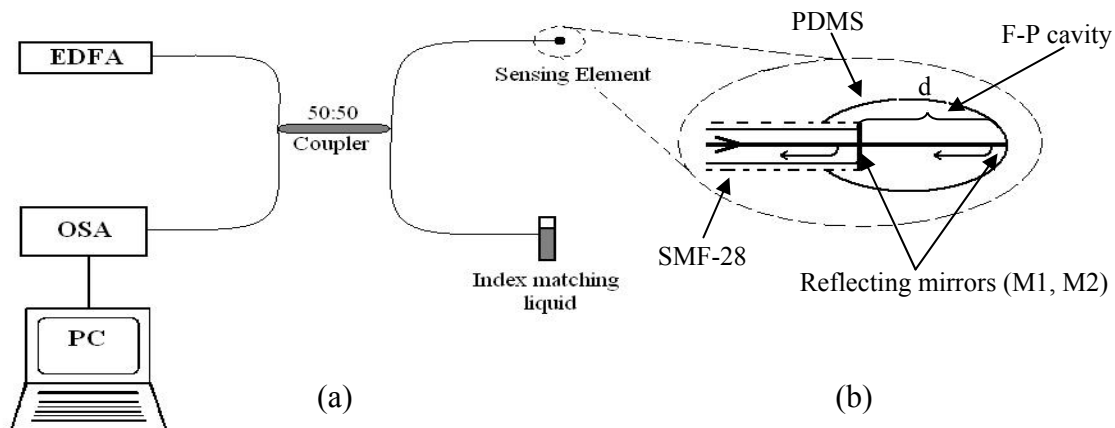


Figure 1: (a) Experimental configuration of the fibre-optic interferometric pressure sensor. (b) Droplet-shaped PDMS F-P cavity of distance d with two reflecting mirrors M1, M2.

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