FBG BASED TEMPERATURE SENSORS DIRECTLY EMBEDDED IN PCB ELECTRONIC BOARDS

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A PCB board equipped with an array of three FBGs for the monitoring of temperature, is described. The possibility of embedding the fiber directly inside the PCB or in very thin steel capillary is demonstrated.
Keywords: Fiber Bragg gratings, temperature monitoring.

1. Introduction

The advantages offered by FBG based sensors, such as low invasivity, immunity from electromagnetic interferences, safe operation in aggressive chemical environment are well known[1].
Aim of the research is the development of a smart component equipped with FBG-based sensors network for the continuous real time monitoring of temperature. The considered component is a standard Eurocard printed circuit board (PCB) with an array of three FBGs embedded inside.

2. Results

The chosen standard for the realization of the smart component is the Single Eurocard (dimensions: 100mm x 160mm x 1.6mm). Given the very small thickness and the necessity to be the less invasive as possible, the fiber chosen for the realization of the FBG was the Fibercore SM1500(5.3/80)P, polyimide coated, with the core and cladding diameter equal to 5.3 μm and 80 μm, respectively. The FBGs were written with the phase mask technique, by using three different phase masks with periods 1059.9 μm, 1061.8 μm and 1070 μm. The length of every FBG was 10 mm, while the distance between them was 65 mm. Being the aim of the research the monitoring of the temperature, two different approaches were adopted: in the first, the fiber was directly embedded inside the PCB, in order to be also sensitive to strain; in the second approach, the fiber containing the three FBG was inserted inside a steel capillary Hamilton 21030A (gauge 30, 0.31 mm outer diameter, 0.16 mm internal diameter, 304 mm in length) embedded in the PCB. This last approach guarantees the sensitivity only to temperature.
The fiber, or the steel capillary, was placed in a groove realised in the inner layer of the PCB, before the fabrication of the prepreg. After that, a sequence of chemical (immersion in sodium hydroxide and in iron(III) chloride), thermal and mechanical (squeezing at ~ 200°C) procedures were actuated for the final realization of the component. Despite the very aggressive processes, both the direct fiber embedding and the capillary embedding were successful. After the production of the PCB, two power resistors (Arcol 19.11) and two LM50 temperature sensors were mounted in correspondence of the FBGs (see Fig. 1a). In Fig. 1b a first temperature characterization of the FBGs inside the steel capillary is depicted.
In conclusion, the possibility of embedding FBG sensors inside a very thin element such as a PCB has been demonstrated.

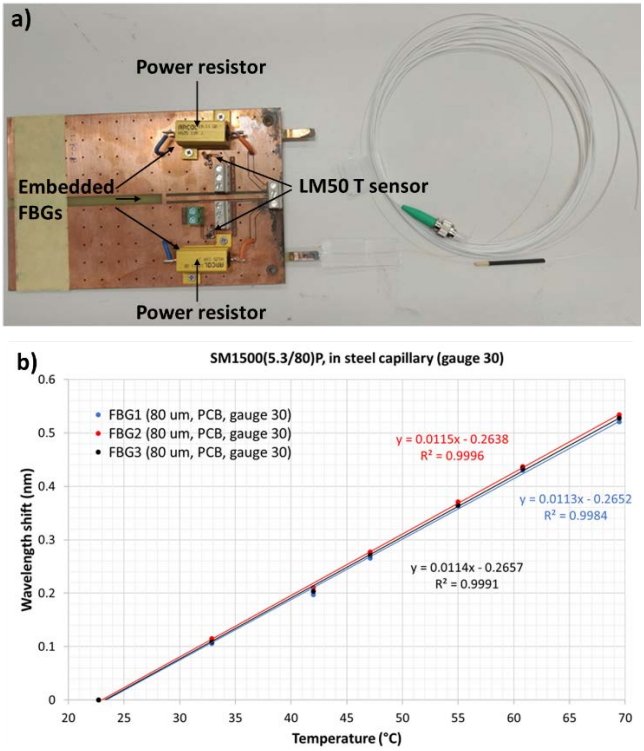

Fig. 1 a) Eurocard PCB with three FBGs embedded inside it and the electronics components for the characterization in temperature. b) Temperature characterization of the FBGs inside the steel capillary.

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