IMPLEMENTATION OF STRAIN GAUGES USING SERIGRAPHIC PROCESS

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ABSTRACT

In this work was established a process of fabrication of strain gauge by serigraphic. The obtained strain gauge present a low gauge factor as compared to that reported in the literature. New tests sing pastes of different characteristics are necessary in order to compare with ours results. But, the preliminary results indicated that the method is promising to fabrication of strain gauges.

INTRODUCTION

While there are several methods of measuring strain, the most common is with a strain gauge, a device whose electrical resistance varies in proportion to the amount of strain in the device. The most widely used gauge is the bonded metallic strain gauge. The metallic strain gauge consists of a very fine wire or, more commonly, metallic foil arranged in a grid pattern. The grid pattern maximizes the amount of metallic wire or foil subject to strain in the parallel direction (Figure 1). The cross-sectional area of the grid is minimized to reduce the effect of shear strain and Poisson Strain. The grid is bonded to a thin backing, called the carrier, which is attached directly to the test specimen. Therefore, the strain experienced by the test specimen is transferred directly to the strain gauge, which responds with a linear change in electrical resistance.

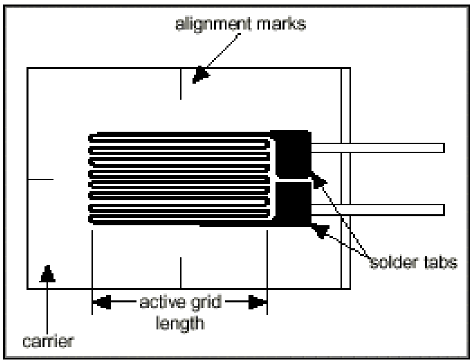

Figure 1 :Bonded Metallic Strain Gauge

It is very important that the strain gauge be properly mounted onto the test specimen so that the strain is accurately transferred from the test specimen though the adhesive and strain gauge substrate, to the foil itself. A fundamental parameter of the strain gauge is its sensitivity to strain, expressed quantitatively as the gauge factor (GF). Gauge factor is defined as the ratio of fractional change in electrical resistance to the fractional change in length (strain).

The first wire strain gauges were developed in 1937-38 originally for military purposes and aeronautics area. They quickly spread to many applications as high precision transducer because excellent linearity, stability and yield. The strain gauges can be used in experimental procedures of strain determination in factory and load cells for commercial transducers. The almost all strains gauges are fabricated using thin film deposited over a plastic substrate (paper, resin or polyamide) and attaching this to the operational structure submitted to strain. In these structure is necessary an operation in elastic regime, and usually stainless steel or aluminum are used, because of theirs high elasticity. In order to achieve a maximum deformation of strain gauges without affecting its sensibility is necessary a special adhesive.

Thus, in this paper we present an alternative process to fabricate strain gauges based in thick films obtained by serigraphic method.

EXPERIMENTAL

The thick films structures for the strain gauges, were obtained by serigraphic process and the strain gauge lay out was performed by AutoCAD and the structure was implemented with the following sequence:

1. Electric isolation using Dupont 3600N paste (4).
2. Sintering @ 850 ºC (figure 4).
3. Serigraphic with Dupont 1610 (silver/ palladium) paste (10 W/).
4. Sintering @ 850 ºC (figure 4).
5. Formation of pad by serigraphic (gold/ palladium)
6. Sintering @ 850 ºC (figure 4).

The mean thicknesses of the dielectric layer and the resistor was 12.15 and 20.10 μm, respectively.

In order to determine the gauge factor and the sensibility, the tests were performed using a stainless steel bar fixed by one side as show in figure 4 a). The strain gage were built by serigraphy over the stainless steel bar as show in figure 4 b). On the free side of the bar the loads were applied with an variation ranging from 0 to 200 g with an step of 10 g.

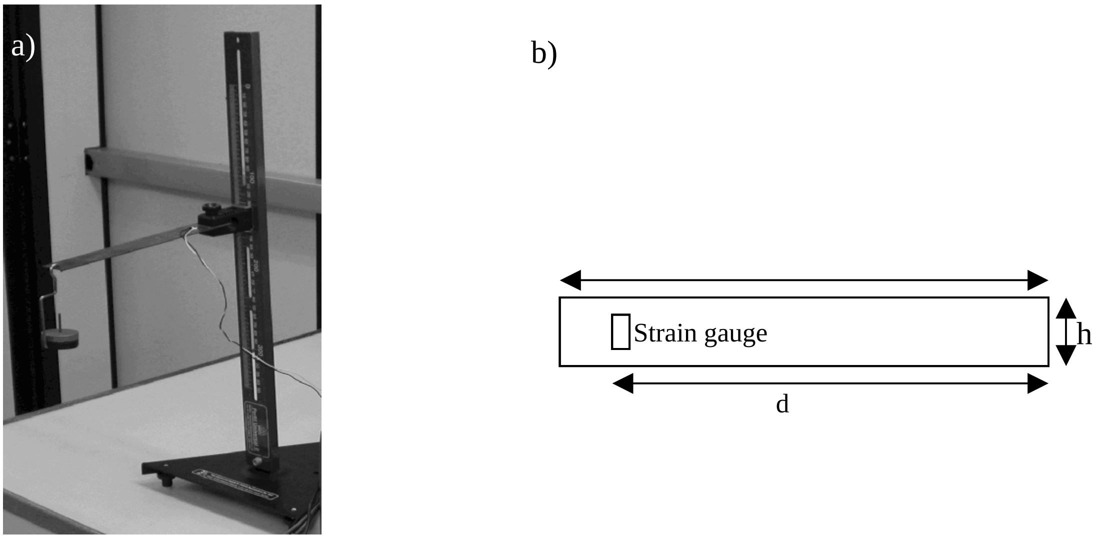

Figure 2: a) Strain gauge position over the bar, b)Experimental apparatus

The strain in the bar can be obtained from the equation 1, and the gauge factor is obtained using the equation. 2.

$$\varepsilon_A = \frac{6Pd}{Ebh^2} \qquad (1) \qquad\qquad GF = \frac{\Delta R / R}{\varepsilon_A} \qquad (2)$$

were d =22 cm is the lenght, b=3 cm is the width, h=1 mm is the thickness of the stainless steel bar, E is the elastic coefficient and P is the applied load.

RESULTS AND DISCUSSION

Figure 4 shows that the resistivity increases linearly with the load applied. The gauge factor obtained from these graph were 2.25. This value is low when compared to the value reported in the literature for thick films strain gauges, as show in the table I [2,3] but is close to that reported for the strain gauges fabricated with other pastes with bigger sheet resistivity and also near to the foil metallic value (GF = 2).

CONCLUSIONS

The process to fabricate the strain gauge by serigraphic was established. In this case the resistors obtained present low sensitivity as compared to literature. Therefore, new tests are necessary with others pastes of different characteristics to compare with ours existent results.

Furthermore, the preliminary results indicated that the method is promising to fabrication of strain gauges.

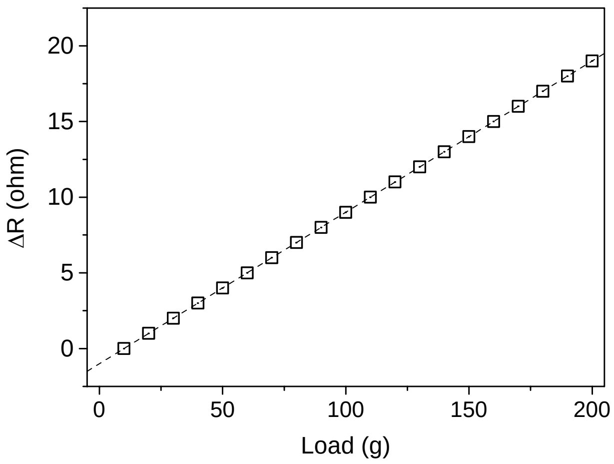

Figure 3: curve of R versus load.

Table 1: GFs on the dieletric-on-steel substrates

Paste	Gage factor
Dupont 4921	9.5
Dupont 8039	7.5
Electro-Science 3414-A	13
Electro-Science 3414-B	14

AKNOWLEDGMENTS

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