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Research Article

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Tensoelectric Characteristics of Control Strain Gage Structure

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Abstract This paper presents the results of an investigation of the tensoelectrical characteristics of a strain gage structures, which are made on the basis of a vacuum sprayed alloy of 45% Ni + 55% Cu and 45% Ni + 55% Cu + Ge (2 ÷ 8) mg. It is established that even a slight difference in the initial parameters leads to a spread of the tensosensitivity coefficient.

Keywords tensoelectric characteristics, tensosensitivity coefficient, strain gage

Introduction

Currently, one primarily uses wirewound and film resistors with resistance of 10 to 1000 Ohm as sensors for measuring force and pressure values [1]. In order to ensure their proper operation and depending on parameters of a specific strain gage, amplification circuits are developed that allow achieving the required settings for recording the useful signal. However, these strain gages have a major drawback. In particular, as a function of temperature, their sensitivity decreases and in order to maintain the accuracy of measurement it is necessary to maintain ambient room temperature, and humidity shall not exceed 30%. Besides that, to ensure stable operation of wirewound strain gages, the diameter of wirewound is made as thin as possible within the range of $d = 0.02 \div 0.025$ mm. Similarly, in film sensors, the thickness is made as thin as 0.0036 mm [2]. Meanwhile, in order to maintain a high tensosensitivity or ensure quality output signal, the value of the operating voltage shall be increased, which in turn leads to increase in the current density and subsequently to additional decrease in the specific sensitivity value.

In the present paper we report the results of the study of the tensoelectric characteristics of strain gage structure.

Samples of strain gages are made by using vacuum-sprayed alloy with composition 45% of Ni and 55% of Cu. The initial resistance was about 500 Ohm. In the stretching mode, as strain value increase the probe's resistance increases as well.

Experimental Samples

Curves of relative change in resistance as a function of relative strain are shown in Figure 1. As seen from the figure samples of strain gages manifest various sensitivity values even at adjacent values of the source resistance. The more the deformation turns out to be, the more the difference will be.

The observed difference, apparently, can be explained by variety of geometric dimensions. As noted in paper [3], the probes with $R_H = 15$ Ohm with width of stripes of 55 μm have a temperature coefficient of resistance (7.9 ... 10.9) $\cdot 10^{-6}$ °C^{-1}, whereas resistors with $R_H = 2.2$ Ohm with the width of stripes of 120 μm have a temperature coefficient of resistance of more than $60 \cdot 10^{-6}$ °C^{-1}. In this case, decrease in the width of stripes with the same film thickness leads to the decrease in the temperature coefficient of resistance. Which means, the issue of optimizing geometric dimensions is of importance and requires special approach to ensure the precision.

In view of the above we propose to identify parameters related to resistance of the strain gage structure, which consists in adding a sequential passive resistance based on the difference in values.

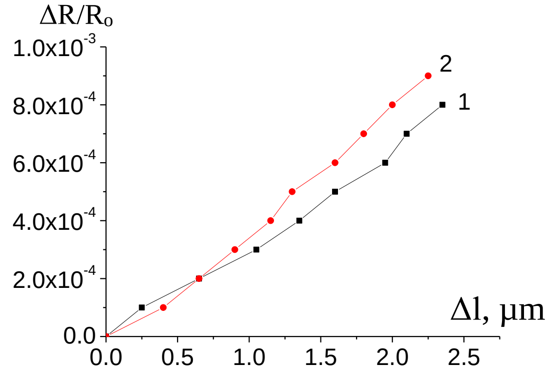

Figure 1: Relative change in the resistance of the film strain gage as a function of relative deformation

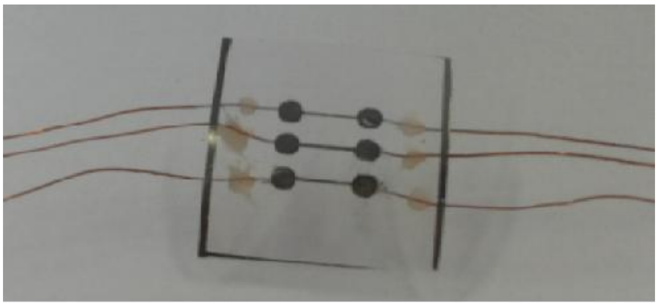

Figure 2: Structures of the film strain gag

Experimental samples of strain gages in three pairs each with different width of stripes were obtained from the alloy 45% Ni, 55% Cu + Ge (2 ÷ 8) mg by applying vacuum-spray technique in the single technological process. General view of the obtained film tensoresistors' structures are shown in Figure 2. Their initial resistance was 500 ÷ 1500 Ohm.

In Figure 3 the dependence of the current on the voltage for one of the experimental strain gage structures is shown. As can be seen in the voltage range up to one volt, the linearity of their volt-ampere characteristic is preserved. Which means that currents up to 5 mA flowing through the sample do not essentially affect their characteristics.

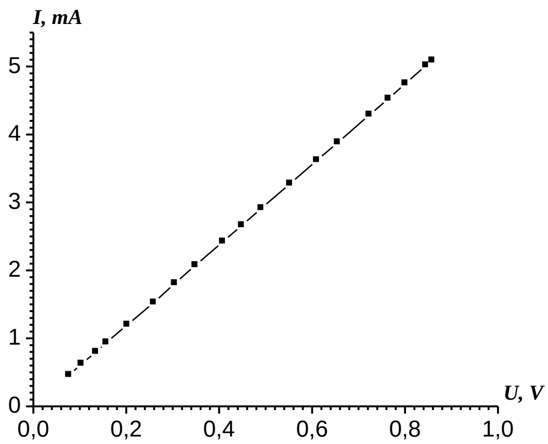

Figure 3: The current-voltage dependence for one of the strain page samples

Thus, the dependence of the resistance of the pilot strain gage on strain deformation is measured. It was revealed that even a slight difference in the initial parameters leads to a spread in the tensosensitivity coefficient. To determine the parameters of the strain gage structures, we propose to choose the right passive resistance by means of connecting in series to samples with lower resistance by the value of the difference in the resistance, which would ensure identical value of strain sensitivity and, accordingly, the output signal.

References

1. Gavryushin S.S., Gavrilenko S.I. Optimization of the elastic element of the load cell. Electronic scientific and technical journal // Engineering Bulletin, 2015. - No. 10. - 518-547 p.
2. Meheda V.A. Tensometric method of measuring deformations / Samara: Samara State Aerospace University, 2011. - 56 p.
3. http://www.russianelectronics.ru/engineer-r/review/2376/doc/48294