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COMPUTER PROCESSING OF THE MEASURED ELECTRON WORK FUNCTION ON THE SURFACE OF ANTIFRICTION MATERIALS

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Abstract

The architecture of an automatic system for precise measurement of the contact potential difference with antifriction materials is represented in this work. Automating of this process provides the possibility to make experiments with different materials under the same conditions that on the one hand leads to simple comparability of the results and significant increase of the precision of the experiment.

Regardless of the great development of thribological science, a series of questions related to the nature of friction and wearing of materials remain obscure which is due to the complex character of the process of their mutual contact, most strongly manifested when working in extreme conditions and particularly with friction and space surroundings [1]. Here, alongside with the traditional frictional surface indices such as micro-geometry and micro-hardness, some physical and chemical parameters that determine its energy state have to be taken in mind. In this sense, the work function of the electron in metals can be used as energy state parameter determining the traditional method of measuring the contact-potential difference between the surface being researched and standard metal surface with constant electron work function [2].

The research of G.P.Shpenkov [3], D.N.Gorkunov [4], as well as some of our studies show that there is connection between surface wear resistance and electron work function in metals, alloys and more complex thribotechnical systems on a metal base. Our research experiments for thribocouples of metal-metal alloy and lead bronze-metal alloys show that when materials are in contact wear increases with increase of the electron work function, and with decrease of their contact potential difference, accordingly.

There are a great variety of factors influencing the physico-chemical state of surface and electron work function. These factors are frequency and smoothness, microstructure and element composition in the presence of oxides and other secondary structures on the surface. To achieve the required precision in determining the contact potential difference and electron work function, especially in complex thribo-technical materials containing a great number of components, it is necessary to use precise registration methods and process large data array in measuring the contact potential difference [5].

In the present work, the architecture of an automatic system for precise measurement of the contact potential difference with antifriction materials is offered. The automatic system is based on a system determining the energy state of surface friction [6]. The recording device used so far in the methods for experimental determining of the electron work function and the antifrictional material surface is oscilloscope. We have introduced an analogue recorder and a personal computer in the accomplished automatic system. The structural diagram of the system is shown in Fig. 1, where: 1 - variable force of outer generator (F~); 2 - electromechanical fluctuating system (EMFS); 3 – electronic-measurement circuit; 4 - oscilloscope; 5 - analogue multiplexer; 6 – monitoring-storage circuit; 7 - analogue-to-digital converter and 8 - personal computer.

In the measurement process, digital ensemble accomplishments of the random process with sufficiently long accomplishment are recorded to be statistically correct. Some measurements have been made, whereas the length of one accomplishment is equal to 255 discrete values of the contact-potential difference, a couple of them for one and the same test specimen. This boosts the statistical fidelity of the signal's automatic digital processing.

The digital processing of measurements is accomplished in the following steps:

1. Scaling of the measured values. The scaling coefficient conforms to the coefficient of amplification and scaling of the scale in spectral measurements.

2. Two types of values are obtained in the process of measuring, stable and unstable. The stable are the real ones, that give us the correct measurement and the unstable are called noise. The noise value is eliminated from the digital signal by means of a filter. The filter sets a window, whose dimensions depend on the mean value of the contact

potential difference. The filter operates in following way: if, for a given specimen, the values are over twice greater or much less than the mean value, they are removed from the spectrum and they are not processed. The next operation is averaging of the values obtained after filtration and their graphic representation. Increasing the number of processing iterations results in increasing the precision of the result. This is achieved because of the fact that, with each subsequent iteration, more and more digital noise values are removed. The conditions under which measurement has been carried out are also important (room temperature; type of the generator - Functional generator 3325A, HEWLETT PACKARD; a source of constant voltage).

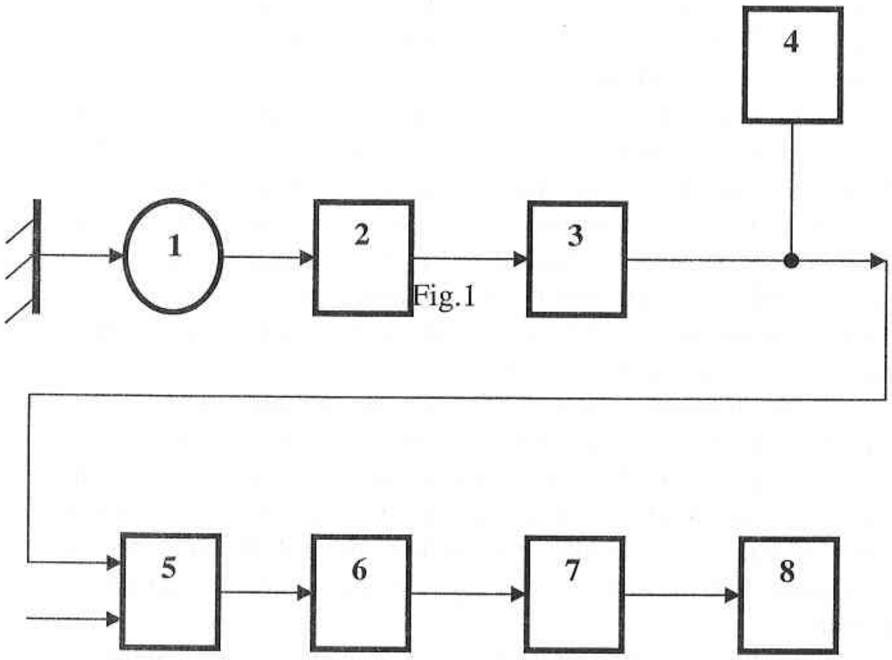

Fig.1

Conclusions:

Automating the process of measurement of the potential contact difference allows to perform experiments with different antifriction materials under one and the same conditions. This provides a possibility for simple comparability of the measurement results. Besides, high precision of the results is achieved because the subjective factor (measurement by oscilloscope) is eliminated and in practice, a sufficient number of accomplishments for achieving the required statistic fidelity of the measurement results can be written.

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КОМПЮТЪРНА ОБРАБОТКА НА ИЗМЕРЕНАТА ОТДЕЛИТЕЛНА РАБОТА НА ЕЛЕКТРОНА НА ПОВЪРХНОСТТА НА АНТИФРИКЦИОННИ МАТЕРИАЛИ

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Резюме

В работата е представена архитектура на автоматизирана система за прецизно измерване на контактната потенциална разлика при антифрикционни материали. Автоматизирането на този процес дава възможност да се извършват експерименти с различни материали при едни и същи условия, което от своя страна води до еднозначна сравнимост на резултатите и значително повишаване точността на експеримента.