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POLYMER - SILICON SENSOR FOR DETERMINATION FLOW

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ABSTRACT

Research stream in sea is an actual problem for studying the physical processes proceeding at oceans and the seas. There are two main problems at development of the sensor contacting to an aquatic environment: if electrodes of the sensors measuring a stream are isolated from water, water pressure renders destroying influence on the sensor measuring a stream; if electrodes of the sensor adjoin to water, the water environment shunts electrodes and brings distortions in physical value of electric parameters of the sensor. We offer the hybrid organic-silicon sensor for measuring simultaneously temperature fields and the space a profile of the heat stream of an aquatic environment. The measurement can be carried out both in near-surface areas, and on various depths in an aquatic environment. The application for this purpose of organic-composite materials allows extending a research range.

INTRODUCTION

At research stream in sea, for decreasing environmental risks of nanobiotechnologies we have developed nano-composite devises based on hybrid organic-silicon matrix. The extended high-resistance organic-silicon sensors have been developed on special matrix technology on the basis of organic nano-composite materials for measurement both temperature of surrounding sea water, and direction of a stream. [1-5] Signals from the sensor, amplified of the operational amplifier, by dint of the interface input into a computer for the further processing results of measurement and archiving of the data. The software package of processing and archiving of results of measurement is created. Laboratory researches of the sensors on measurements heat stream are carried out.

EXPERIMENTAL PROCEDURE

Research stream in sea is an actual problem for studying the physical processes proceeding at oceans and the seas. There are two main problems at development of the sensor contacting to an aquatic environment: a) if electrodes of the sensors measuring a stream are isolated from water, pressure of water renders destroying influence on the sensor measuring a stream. b) if electrodes of the sensor adjoin to water, the water environment shunts electrodes and brings distortions in physical value of electric parameters of the sensor.

We offer the hybrid organic-silicon sensor for measuring simultaneously temperature fields and the space a profile of the heat stream of an aquatic environment. The measurement can be carried out both in near-surface areas, and on various depths in an aquatic environment. The application for this purpose of organic nano-composite materials allows extending a research range.

Development of new organic nano-composite materials, prediction and improving of their characteristics depends from binding which one is the major component of composite materials. In this connection recently the investigations in the field of an organic materials technology in particular organic nano-composite materials, were increasing. [6-8]

The material of the matrix sensor consists of three components:

- Polymeric component of a sensor, for collimating to a sensor of pliability, a technological Q-factor and providing high resistive of the sensor;
- A piezoelectric filling compound in the form of slurry (the sizes of nano-particles are less 0,1 μm.) in the sensor (comminuted and mixed in a polymer), for amplification of accumulation of charges on surfaces of a matrix and direction finding of a motion of an aquatic environment;

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- Thermo-filling - a semiconductor (silicon) filling compound in the form of magnetic character slurry (the sizes of nano-particles are less 0,1mkm.) for provision thermo-sensitivity of a sensor. [9]

As an organic material it is possible to take polytetrafluoroethylene (teflon-4) or polyethylene. On insulating properties teflon-4 belongs to best of known dielectrics.

Teflon-4 is more chemical persistent than noble metals that allows using it at manufacture of the isolation working in corrosive environments. Teflon-4 is not combustible, is not hydroscopic, and is not wetted with water and other fluids. Polyethylene is more technological, relative a low-cost and more polarizable material. As the piezoelectric filling compound we used PKR-8, PKR-3 or CTS-300 because a coefficient $\boldsymbol{d_{33}}$ is high. The piezoelectric modulus d_{33} characterizes a density of charge formed on plates of an exemplar at action mechanic exertion in a direction, previous polarization. For example, CTS-300 has a density of charge $\boldsymbol{d_{33}}$= 280pC/N, $\boldsymbol{\varepsilon}$=100, $t_{к}$ = 330°C. For getting the sensor unit semiconductor heat-sensitive and piezoelectric materials immix on special technique with powdered polystyrene before achievement of homogeneous mixture. Current-output electrodes in the form of an elastic strip are superimposed in a uniform work cycle. The got exemplar is enveloped by a clean polymeric material for removal shunting in an aquatic environment (Figure.1).

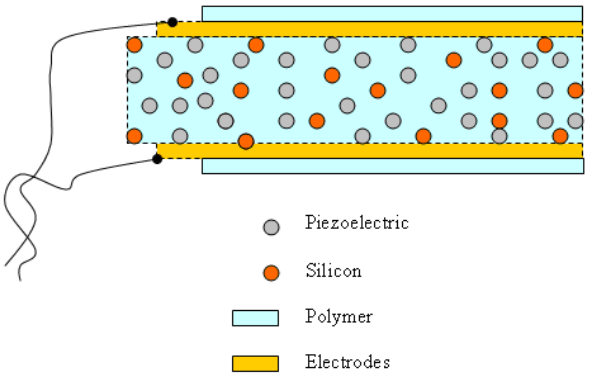

Figure 1. Cross-section of a hybrid organic-silicon matrix sensor.

RESULTS AND DISCUSSION

On Figure 2 the operating principle of the hybrid organic-silicon matrix sensor is displayed in one plain. Under action of a stream the matrix detector is bended on angle Δφ from a planar state. In depending on direction of the stream $\boldsymbol{\Delta\varphi > 0}$ or $\boldsymbol{\Delta\varphi < 0}$, we have an identity

***sign (I) = sign* (Δφ),**

Where: $\boldsymbol{I = f(\Delta\varphi)}$ – is an amplitude of a signal. Therefore at measuring output current ***I*** depending on a time ***t, I =F (t),*** we get the diagram displayed on Figure.3.

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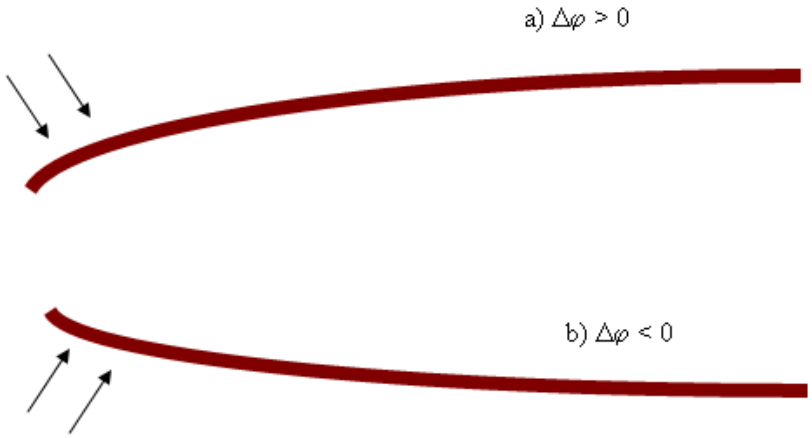

Figure 2. Operating principle of a hybrid organic-silicon matrix sensor in one plain.

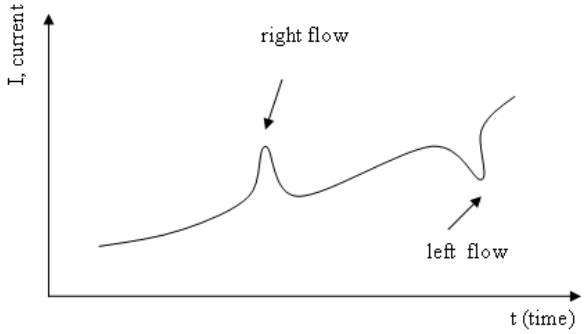

Figure 3. Variation of output current I from a time t.

The direction of current variation *I* display a streamline of current of an aquatic environment (on Figure 3 it is visible in the form of sharp plus (up) or subzero (down) spikes). A degree of current ***I*** increase is proportional to temperature ***T*** of an aquatic environment. Calibrating a hybrid organic-silicon matrix sensor in standard basins with known streams and temperatures it is possible to plot graphics **I = f (Δφ)** in absolute units. For measuring the space of a profile of a stream in three plains we can use the module with three matrix sensors in three directions.

CONCLUSIONS

At occurrence of a stream in an aquatic environment the elastic strip of the sensor bends in the same direction and electrodes are polarized (a direction of polarization depends on a direction of a bend). The occurred charges are been collected out from electrodes, amplified by charge-sensitivity, and converted by an Analog-Digital Converter and move on an input of a computer. The special program in a computer analyses the signals entered from the module of sensors, defines temperature of an aquatic environment and a profile of a stream of current and records in a data memory. In the subsequent these data are used for construction of a temperature field and a stream of current in an aquatic environment.

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