FORMATION OF NANOSIZED ELEMENTS OF HYBRID SYSTEMS MICROFLUIDICS ON A SILICON SUBSTRATE

Vadim Polyakov

Modern technology to create intelligent systems-on-chip, artificial DNA molecules, to control the processes of reproduction and reproduction of biological tissues. Solid-state technology allows devices with size of about 20 nm. The actual task, which is able to make a breakthrough in the near future is the creation of devices and interconnected based on the splicing of the animate and inanimate in touch devices and systems.

Specifics created the modern devices used for their production processes, physical, chemical, and biological bases of functioning us to speak about the close relationship and the need for interdisciplinary linkages in the design and development of hybrid systems. Interdisciplinary knowledge will be towards creating for monitoring the environment and humans hybrid sensor systems. Hybrid system is a system that contains components that made using different materials and technologies, interconnected on a single structural basis.

One of the features of some touch devices is that hybrid systems combine organic and inorganic elements. This is usually different functional elements (electrodes, biosensors, channels), which are made of various materials (metals, silicon, organic elements). Of particular importance in the design and development of sensor systems is set to size factor. Accordingly, for biological objects such as DNA (width - units of nanometers in length and units of micrometers), proteins (few tens of nanometers), viruses (sizes up to 100 nm), bacterias (from 1 nm to 10 μm), cells (from 10 μm to 100 μm) you must be have the appropriate geometric dimensions of the elements of the hybrid devices.

One should dwell on the important elements of the hybrid sensor systems lab-on-chip (LNC). Lab-on-chip is a device the size of which ranges from a few square

millimeters to several square centimeters. LNC on the same chip can be one or several laboratory functions. Usually the LNC combines components of microelectromechanical systems (MEMS) - based microfluidic system. The design feature of the LNC is modular. Each module has its own specific tasks and autonomy. For example, channels, valves, pumps, tanks for blood samples and various bioreagents are formed in the polymeric material, and the silicon substrate microfluidic chip. LNC divided into systems with capillary control, pressure control, centrifugal, electrokinetic and acoustic.

Semiconductor materials (silicon, silicon carbide, gallium arsenide) can be used as the basis for building complex hybrid systems. The most of promising processes of forming elements of hybrid systems are:

- method of focused ion beam used in the semiconductor technology.

- local anodic oxidation for forming elements of the LNC on the surface of a semiconductor or metal.

- LIGA technology is one of the most popular technology LNC micromechanics method. The main advantage of LIGA technology is a precision, low roughness of the walls, high aspect ratio

- rapid thermal annealing (RTA) whis halogen lamps used.

Given the relevance of the materials used in the production of hybrid sensor systems in our opinion, a promising material is titanium. Titanium is used in medicine since the beginning of the last century and proved biocompatible material. Memristors properties of titanium oxide allow you to use it as a memory cell, and in the future will be able to replace the transistors.

Based on the analysis of the technological aspects and design features hybrid touch you can make the following conclusions. To create hybrid systems with characteristics such as selectivity, high sensitivity, safety of use, low cost and should be used in methods of group processing and technology of microelectronics, nano - and Microsystem technology. It is necessary to carry out the selection of materials and their combinations from the point of view of biocompatibility.

This work was executed in Centre Collective Use of Equipment and the

Research and Education Centre "Nanotechnology" Southern Federal University.

1. Polyakov V.V. Development and study of silicon dioxide nanostructured films forming on semiconductor structures surface // In book Advanced nano- and piezoelectric materials and their applications, Edit. I. Parinov – Nova Science Publishers, USA, 2014. – P.19-60. (ISBN:978-1-63321-239-8)

2. Ageev O.A., Alyabeva N.I., Konoplev B.G., Polyakov V.V., Smirnov V.A. Photoactivation of the processes of formation of nanostructures by local anodic oxidation of a titanium film // Semiconductors. 2010. T. 44. № 13. C. 1703-1708.

3. Sechenov D.A., Svetlichny A.M., Polyakov V.V. Photostimulated technological processes in silicon structures. - Taganrog: TSURE, 2002. – 103 p.

4. O.A. Ageev, Blinov Û.F., Ilyin I., etc. Memristors effect on the beams vertically oriented carbon nanotubes in the study by scanning tunneling microscopy // Journal of technical physics. 2013. T.83. N 12. - P.128-133.