зниження чутливості радіометра. Авторами [3] запропоновано методику та алгоритм корекції температурних змін елементів схеми вибіркового підсилювача, що полягає в наступному.

В схему вибіркового підсилювача введено джерело опорного сигналу, еквівалентного вихідному сигналу за максимальної чутливості радіометра.

В якості частотозалежних елементів фільтра вибрані опори каналу витік - стік польових транзисторів (ПТ), а значення опору регулюється подачею на затвор ПТ відповідної напруги. Польові транзистори увімкнені послідовно з резисторами, які регулюють центральну частоту та охоплені зворотним зв'язком.

Налаштування схеми проводиться за нормальної температури 20^0 С. Зміна температурив у той чи інший бік призводить до зміни вихідної напруги і порушення рівноваги в колі зворотного зв'язку. Виділене різницеве значення напруги подається на затвори польових транзисторів і проводиться корекція АЧХ фільтра та коефіцієнта підсилення до встановлення втраченої рівноваги та забезпечення необхідної чутливості.

Ключові слова: модуляційний радіометр, шум, вибірковий підсилювач.

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MINI POWER CONVERTERS BASED ON A NANOSTRUCTURED SILICON FILM FOR PHOTOVOLTAIC ENERGY HARVESTING

[1)]Melnichenko M. M., [2)]Bozhko K. M., [2)]Bochkova O. P.
[1)]Taras Shevchenko National University of Kyiv, Kyiv, Ukraine
[2)]National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine
E-mail: bozhkonew@ukr.net

Modern nano-technologies are a set of technological methods that allow the creation of nano-objects and their control at the nanometer level. In recent years, methods of producing nanostructures based on chemically pure silicon for use in photonics, photovoltaic devices, energy storage devices, biophotonics, and biosensors have been actively developed [1-5].

Modern wireless sensor networks consist of many sensor devices to collect and transmit the data they collect. Various types of sensors (ultrasonic, gas, temperature, and motion), with difficult access to the power source, are equipped with batteries as a wireless power source. However, these batteries have a limited life span and require periodic replacement. Thus, batteries cannot be suitable for use in biomedical devices [6], environmental or industrial monitoring [7-9], and the military sphere [10, 11]. Therefore use of environmental energy, as an alternative to an electrochemical battery, with a limited lifetime, is preferable for such electronic devices. Micropower energy harvesters can significantly extend battery life where battery replacement is difficult or impossible.

Among various types of environmental energy, such as motion, vibration or sound, thermal or wind, solar [12, 13] has great potential for energy harvesting due to its abundance. It is a virtually inexhaustible source of energy with little or no negative impact on the environment. Electricity is generated by converting solar radiation (both indoors and outdoors) into direct current electricity using semiconductors that exhibit a photovoltaic effect.

This paper presents an effective and inexpensive method of texturing the silicon surface to obtain nanostructured silicon layers with different morphology and distribution of chemical elements on the surface of the substrate.

The presented method, of forming nanostructured silicon films by chemical etching, demonstrated good reproducibility of the results. This was confirmed by repeated experiments and the high homogeneity of the formed nanostructured silicon films. Single-crystal silicon wafers for the production of solar cells were the subject of experiments. The plates were boron-doped and had P-type conduction. The substrates had a resistivity of 1 Ohm / cm^2, (100) crystallographic orientation, and a thickness of 350 μm. It should be noted that the most homogeneous samples are with a thickness from 10 to 35 nm.

The best anti-reflective characteristics have samples of nanostructured silicon with a thickness of 35 nm, characterized by bright intense photoluminescence and high homogeneity of properties over the sample area. During the formation of nanostructured silicon on monocrystalline silicon substrates, the structural properties change, and new silicon compounds with a high content of hydrogen and amorphous silicon are formed on the surface. Such a complex structure causes the emergence of new electrophysical, photoelectric and photoluminescent properties. The study of current-voltage characteristics of nanostructured silicon was performed in the visible range of the spectrum (Fig. 1, Fig. 2). It was found that the maximum photosensitivity in the visible range of the spectrum is characteristic of nanostructured silicon films with a thickness of 10–15 nm, and it decreased with the increasing magnitude of the latter.

The structures of monocrystalline p-type silicon - nanostructured silicon - aluminium, created based on the obtained films of nanostructured silicon, showed a photoelectric effect. Among the tested layouts, the best results were obtained for a structure with a nanostructured silicon film thickness of 35 nm and the parameters shown in Fig. 3.

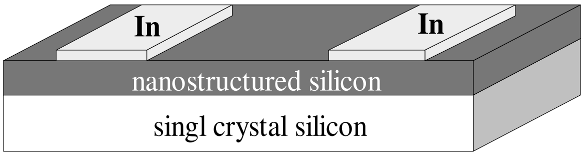

Fig. 1. Schematic representation of the structure single-crystal silicon p-type – nanostructured silicon – indium

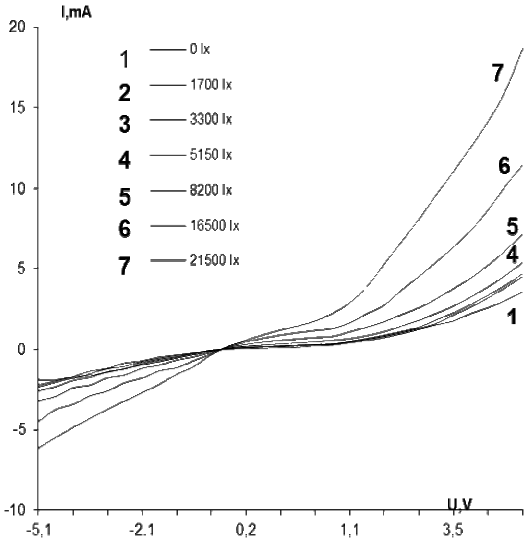

Fig. 2. Light and dark current-voltage characteristics of the nanostructured silicon film

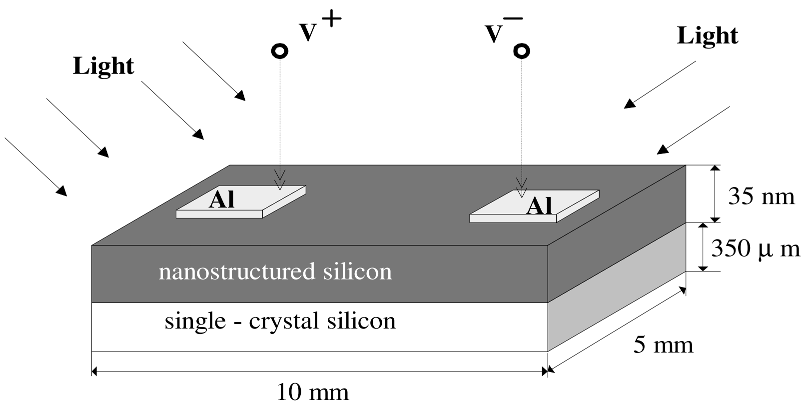

Fig. 3. Schematic representation of the device for harvesting photovoltaic energy of indoor illumination (electric and/or solar) (photocell area - 0.5 cm^2)

The resulting photocell had an area of 0.5 cm2. In this case, the resulting structures show a photoelectric effect (0.2 V, 90 μA under load) under indoor illumination (electric and/or solar). The resulting mini power converters based on a nanostructured silicon film can be combined in panels to obtain the required voltage or current. Created mini power converters, based on a nanostructured silicon film, and their panels, can be integrated into electronic circuits and ready-made chips for various purposes with low power consumption. The latter opens up the possibility of using nanostructured silicon in photonics, photoelectric devices, biophotonics, and biosensorics.

Keywords: nanostructured silicon, photovoltaic energy, current-voltage characteristics.

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DEVICE FOR RESEARCH OF SURFACE PROPERTIES OF LIQUIDS BY GAS JET METHOD

Bodnar R. T.
Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, Ukraine

Many technological processes of ore flotation, oil and gas production, well drilling, as well as in the production of man-made fibers, rubber, plastics, in the pulp and paper and other industries use solutions of surfactants. For the purpose of optimal carrying out of such processes constant or periodic monitoring of surface tension