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PbS-BASED IR-SENSITIVE PHOTOELECTRICAL DETECTORS AND MATRIXES BUILT-IN A SILICON SUBSTRATE WITH SCHEMES OF DATA PROCESSING

PbS-based optical thin-layer detectors have been used as IR-sensors in the 0.6-3 mm region of spectrum in scientific, industrial and military applications for the last 30 years. However, nowadays the development of non-cooled multi-element matrix modules with PC-compatible interface is a very important task for physicists, technologists and electronicians. In this report we shortly presented all steps of such device had been developed from a single photosensitive photoresistor to a 256·256 element matrix module based on PbS layer integrated into the silicon chip with PC-compatible schemes of data processing.

First step — Preparation of PbS photosensitive IR-detectors on a silicon substrate. The main task of this step was to develop a comfortable and reliable technology for preparation of high-sensitive IR-detector based on PbS

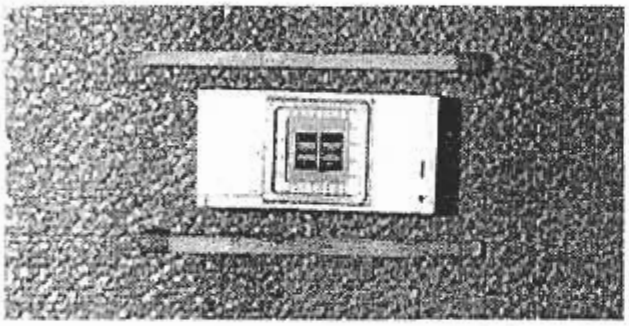

Fig. 1

films with good adhesion with silicon in order to create a device with sensitive module and implanted electronic schemes for signal or data processing in a single silicon chip [1]. We proposed new spray method and improve properties of PbS films to be prepared by the set of technological parameters [2]. Besides, the new structure of samples has been made in order to obtain a good adhesion of IR-sensitive p-type layer of PbS with silicon by adding of new n-type of PbS interlayer which is not sensitive in IR region of spectra between a silicon substrate and p-type photosensitive operating film [3]. After this we optimized photoelectrical parameters of such detectors by adjusting of structural properties of operating body of these detectors, for example, sizes of polycrystallines by choosing of some technological parameters (temperature of spraying, temperature of substrate during the process, spraying rate, composition of operating solutions, etc.) and controlled obtained films using electron microscopy and roentgen methods [4, 5]. Photo of industrial sample is presented here. This sample has two sensitive units with golden contacts and built-in the integrated circuit case.

Second step — Studying of electrical and photoelectrical properties and development of a theoretical model and mechanisms of photoconductivity of such structures. In this step wide range of different properties have been investigated [6-10]. Here were found new electrical and photoelectrical properties and effects in thin polycrystalline PbS films [11—12]. Theoretical model of photoconductivity of such structures in a basis of new discovered mechanisms of electrical and photoelectrical properties have been proposed [13—15]. Besides, this model was used for other physical objects [17] with the same mechanisms of conductivity. These investigations have been used as the base to develop of non-cooled multi-element matrix IR-photosensitive modules built-in the silicon substrates [15—16].

Third step — development of non-cooled matrix photosensitive modules and theoretical model of distribution of temperature on their surface. Previous results were used for developing of matrix modules with 256·256 elements with PC-compatible schemes for data processing. The rectangular matrix modules can

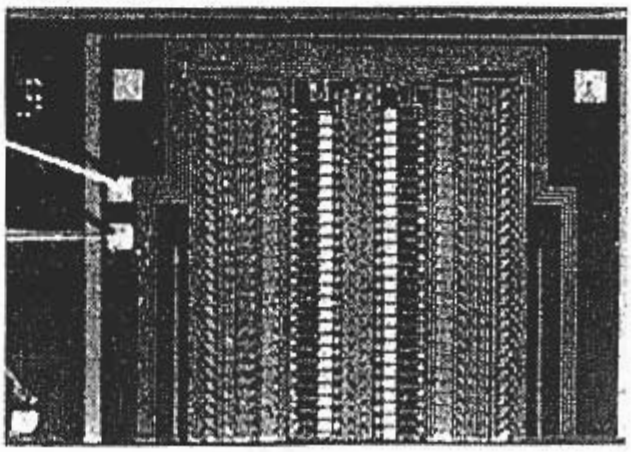

Fig. 2

work in two different modes of operation. At first mode all sensitive elements and schemes for data processing operate simultaneously, but at second mode only one element of matrix operates at any moment of time. Optimization of thermal mode of operation of such non-cooled multi-element matrixes was very important problem due to observed effects in Step 2. Some theoretical models and calculations have been presented during this part of investigations [18—21].

Now we work under development of PC-compatible interface schemes built-in matrix module and improvement of sensitivity these devices in comparison with other existed models produced by well-known manufacturers.

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