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TEMPERATURE AND DEPENDENCE OF PHOTOCONDUCTIVITY AND STRUCTURES MN_4 SI 7-SI<MN>- MN_4 AND_7

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ABSTRACT
This article studies the effect of infrared radiation and temperatureson the parameters of higher manganese silicides on the surface of silicon created on the basis of impurity atoms of manganese. The possibility of creating effective thermocouples and photodetectors based on the structures of Si_xMn_{1-x-Si}<Mn>- Mn_xSi_{1-x} is shown.

Keywords: manganese, higher silicides, silicon, diffusion, contact, surface, infrared radiation, temperature.

Metal or silicidea contacts with a high-impedance semiconductor are known to create potential energy that has a great influence on measurement results and on the operating parameters of semiconductordevices. This is due to the fact that when an external voltage is applied, one tothe ontact shifts in the forward, and the other in the opposite direction.
For the studyof the temperature dependence of photoconductivity, the structures Si_4Mn 7-Si<Mn>-Si_4Mn_7 with a high-altitude base based on the original silicon of the KDB-10 brand were obtained. The studyof the temperature dependence of the photoconductivity of the obtained structures of type Mn_4Si 7-Si<Mn>-Mn_4Si_7 has established that at certain temperature values (T = 150÷200 K) there is a strong decrease in the photocurrent associated with it. o with temperature quenching of observed many semiconductor materials [1-4]. It has been established that theemperaturn quenching of photoconductivity is a thermoelectric feedback between the magnitude of the current and the temperature at the interface between the higher silicidesof manganese (HCM) and silicon doped with impurity atoms of manganese Si<Mn> at To explain the physical mechanism, it is necessary to considerthe zone diagram of the structure under study [5-7]. The basic region of the structure Si<Mn> at low temperatures and illumination by its own light becomes a quasi-equilibrium hole hole Conductivity with a current carrier concentration of the order $p \approx 10^{14\ cm^{-3}}$. In this state, the fermi quasi-level for holes-E_{Fp} in the forbidden silicon zone is close tothe ceiling at the valence band and takes a

value of $E_v + E_{Fp}$ = 0.18 eV. Bythe vasius level of Fermi dla electrons-E $_{Fn}$ due to the adhesion of electrons to the levels of once ionized impurity atoms of manganese Mn^- will rise from the middle of the band gap by the value E_c - E_F n $\leq$ 0.3 eV. When such a quasi-non-equilibrium state is in the zone, a slightly applied voltage leads to linear heating in the photocurrentsand the resulting structures. Investigation of the temperature dependence of the photocurrent in such structuresah showed that there are many sites that are very differentfrom each other[8].

The first section (increasing) has an inclination characterized by the activation energy of the level located on the lower halfe of the prohibited silicon zone F_{v+} 0.18 eV. When the structures in the base region are heated, electrons are generated from the valence band with a transition to the level E_v + 0.18 eV, since the quasi-level of Fermi E_{Fp} is below this level, which leads to a gapfromthe dragand from Electrons. At certain values, the temperature of the market fills the e lower level with electrons and the Fermi quasi-level for holes E_{Fp} shifts upwards (to the middle of the forbidden zone E_g). In this case, there is an increase in the concentration of holes in the valence band, which leads to a decreasein thetemperature of the studied structures. In the process of heating the base, the base is displaced by the fermi quasi-levelof electrons-E $_{Fn}$ to the middle of the prohibited However, the energy values of both the acceptor and donor levels of manganese differ almost twice. A change in photocurrent leads to an increase in the temperature of the base of structures based on silicon doped with manganese atoms, which affect each the energy levelis in the corresponding temperature region. It is establishedthat such electronic transitions in the structures Mn_4 Si_7- Si<Mn>-Mn_4Si_7 occurin the temperature range T = 80÷150 K.

The second region, which relates to a rapid decrease in photocurrent with an increase in temperature in the range T = 180÷200 K, can be explained as follows. As the temperature rises, the Fermi quasi-level of electrono-E $_{Fn}$ begins to intersect with the level of manganese, and then shifts to the middle of the silicon band gap. This leads to thermal emission (thermal ejection) of electrons from M n levels into the conduction band with their subsequent recombination through an uncontrolled level-N $_r$ with valence zone holes. In turn,this leads to a decrease in the concentration of holes and, consequently, to an increase in the resistance of the basic region of the structure, i.e. temperature quenching of photoconductivity. The increase in resistance in the basic region of the structures, in turn, leads to a redistribution of the electric field in the transitional region of contact with the potential barrier. in the area of its base, as a result of which the rate of decrease in current is accelerated by more than 2.5÷3 orders (Fig. 1).

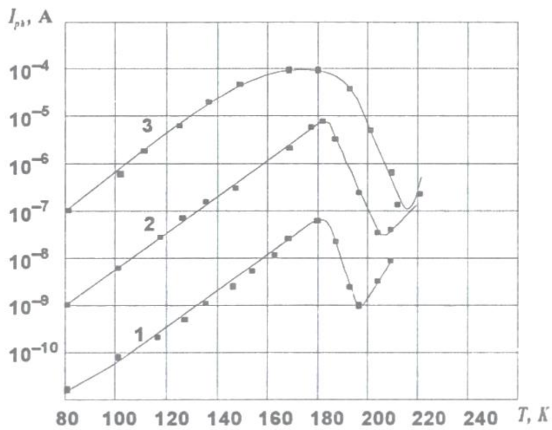

Figure 1. Temperature dependence of the photocurrent in the structures of HSR-Si<Mn>-HSR at differentandx appliedandx voltages of 1-10 V; 2-100 V; curve 3-100 V.

From the analysis of the results of studies of photoelectric characteristics obtained by st. ruktur $Mn_4Si_{7\text{-}Si}$<Mn>-Mn_4Si_7 and $Mn_4Si_{7\text{-}Si}$<Mn>-M at different radiation densities and applied electric field voltages from 50 to 100 V in the temperature range T = 80÷240 K. a region of negative differential photoconductivity

(ODPP) appears. It is also shown that the ODF P site shifts towards lower temperature values with a decrease in radiation intensity.

These results of the study once again showed the unique physical properties of the obtained structures and the possibility of creating thermal batteries, a photo receiverof IR radiation and temperature sensors on their basis.

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