2043	53	425301.9518	658300.9518	232999
2044	54	433516.769	666515.769	232999
2045	55	441731.5862	674730.5862	232999
2046	56	449946.4035	682945.4035	232999
2047	57	458161.2207	691160.2207	232999
2048	58	466376.038	699375.038	232999
2049	59	474590.8552	707589.8552	232999
2050	60	482805.6725	715804.6725	232999

4-rasm prostate saratoni kasalliki soni linear argorithm orqali 2050-yilgacha bashorat qilinishi.

4-rasmda formuladan olingan natija 2023-yilda prostata saratoni kasallikidan vafot etganlar soni 486836 nafar edi bizning linear argorithm orqali 2050-yilgacha bashorat qilinishi 715801 nafarga yetadi [1].

9-formulada esa koeffitsienti aniqlandi $\hat{W}_0 = \bar{Y} - \hat{W}_i$ $\dot{X}$ = -10083, $\hat{W}_i = \frac{\sum(Y_i - \bar{Y})(X_i - \dot{X})}{(X_i - \dot{X})^2}$= 8214,817241

Adabiyotlar

1. https://ourworldindata.org/grapher/total-cancer-deaths-by-type.
2. Sun'iy intellekt tizimidagi machine learning metodalogiyasidan foyalanib prostata saratoni FAN va JAMIYAT Ilmiy-uslubiy jurnali 2023 4-soni.
3. https://kyushu-u.elsevierpure.com/en/publications/a-fast-algorithm-for-unbounded-monotone-integer-linear-systems-wi.

REZYUME. Deep learning va Machine learning metodlaridagi linear regression algorithmlar orqali 1989-2023-yildagi aholi soni ya'ni 34 yillikini olib modelimizga solganimzda 1989-yilda aholi soni 5223704000 nafar edi 2050-yilga kelib 10340540799 tani tashkil etish bashoratlangan. Prostata saratoni kasallikidan vafot etganlar soni esa 1990-yilda 232999 ta 2050-yilga kelib esa bizning linear algoritimdagi model orqali 715804 nafar bashoratlandi. Lienar regression algorithm modeli orqali kelajakda statistik ma'lumotlardan foydalanib ma'lumotlarni o'sishi va kamayishini aniqlashimiz va shu ma'lumotlarga tayanib aholiga oziq ovqat mahsulotalirini yetishtirishni va prostata saratoni kasallik uchun proflaktik tadbirlarni oldini olishimiz va inson salomatlikini ta'minlashimiz zarur.

РЕЗЮМЕ. Используя линейные алгоритмы глубокого обучения и методы машинного обучения, когда мы взяли население 1989-2023 годов, то есть 34 года, в нашу модель, население в 1989 году составляло 5223704000 человек. К 2050 году было предсказано, что оно составит 10340540799 человек. Число смертей от рака простаты составило 232 999 в 1990 году и 715 804 к 2050 году было предсказано нашей моделью линейного алгоритма. С помощью модели алгоритма Лиенара нам необходимо определить увеличение и уменьшение данных с использованием статистических данных в будущем, и на основе этих данных мы можем предотвратить производство продуктов питания для населения, предотвратить профилактические мероприятия по раку простаты и обеспечить здоровье человека.

SUMMARY. Using the linear regression algorithms of deep learning and machine learning methods, when we took the population of 1989-2023, i.e. 34 years, into our model, the population in 1989 was 5223704000. By 2050, it was predicted to be 10340540799. The number of deaths from prostate cancer was 232,999 in 1990, and 715,804 by 2050 were predicted by our linear regression algorithm model. Through the Lienar algorithm model, we need to determine the increase and decrease of data using statistical data in the future, and based on this data, we can prevent the production of food products for the population, prevent prophylactic measures for prostate cancer, and ensure human health.

EXPOSURE TO HEAT TREATMENT ON THE ENERGY SPECTRUM OF DEFECTS IN SILICON DOPED WITH MOLYBDENUM

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Nukus state pedagogical institute named after Ajiniyaz

Tayanch so'zlar: kremniy, nopoklik, molibden, electron-neytral aralashma, kislorod, uglerod, nuqson hosil bolishi.

Ключевые слова: кремний, примесь, молибден, электронно-нейтральная примесь, кислород, углерод, дефектообразование.

Key words: silicon, impurity, molybdenum, electron-neutral impurity, oxygen, carbon, defect formation.

Introduction. The properties of silicon doped with impurities of refractory elements are of great interest to researchers in connection with the search for semiconductor materials with increased thermal stability and radiation resistance [1-6]. It is known that many impurities that create deep levels in the band gap of silicon during their diffusion doping, when introduced into single-crystal silicon during its growth from a melt, are in its lattice in an electrically inactive state [7-11].

Authors [12] found that Mo in n-type Si is reported in only a few sources. An unidentified peak was found in the n-type epitaxial channel. Determined with the deep level transient spectroscopy (DLTS) method with an activation energy and a capture cross section of 0.255 eV and $3.5 \cdot 10^{-16}$ cm^2, respectively. These results are consistent with measurements of n-type silicon implanted with Mo.

Experimental part. For the experiments, we used samples of Si doped with a refractory element, molybdenum. The control samples were wafers of polished n-type and p-type silicon grown by the crucibleless zone melting method and the Czochralski method under the same conditions as Mo-doped Si (but without impurities). The infrared absorption spectra (IR absorption) in the initial Si and Si<Mo> samples were measured using a Specord-IR-75 infrared spectrophotometer operating in a two-beam scheme [13].

The concentrations of optically active oxygen and carbon atoms in the initial silicon samples of n and p-type conductivity grown by the crucibleless zone melting method and the Czochralski method were, respectively, N_O^{opt}~10^{16} and (5-12)$\cdot 10^{17}$ cm^{-3} and carbon N_C^{opt}=(2-12)$\cdot 10^{15}$ cm^{-3}, the resistivity of the original samples was 5÷20 Ohm·cm, the thickness of the polished samples, depending on the task, was 1÷1.5 mm. The content of oxygen N_O^{opt} and carbon N_C^{opt} were estimated from the IR absorption spectra in the range of wave numbers k=1100 cm^{-1} (oxygen band at 9.1 μm) and k = 610 cm^{-1} (carbon band at 16.4 μm), measured at 300 K. Polished oxygen-free silicon of the same thickness as the test sample with $N_O^{opt} \leq 10^{16}$ cm^{-3}, N_C^{opt}=$5 \cdot 10^{15}$cm^{-3} was used as a control sample.

Results and its discussion. Previously [14], we showed that molybdenum atoms introduced into silicon during growth are electrically neutral. It is also described here that in diffusion doping of silicon with Mo impurity, deep levels are formed with ionization energies E_C–0.20 eV (peak A) and E_C–0.29 eV (peak B) with electron capture cross sections $\sigma_n = 2 \cdot 10^{-17}$ cm^2 and $\sigma_n = 4 \cdot 10^{-16}$ cm^2 in n-Si<Mo>.

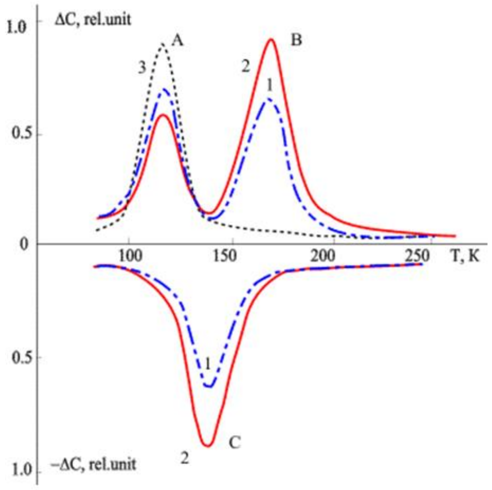

Fig.1. *DLTS spectra of n-Si<Mo> and p-Si<Mo> samples doped with molybdenum at 1000 °C and 1200 °C (curves 1 and 2) and control heat-treated n-Si samples (curve 3)*

In the p-Si<Mo> samples, one deep level was found with an ionization energy E_V+0.35 eV (peak E) and a hole capture cross section $\sigma_p = 7\cdot10^{-15}$ cm^2 (Fig. 1, curves 1-3). Possibility of activating Mo atoms introduced into silicon during growth during high-temperature annealing (HTA). For this purpose, the effect of various HTAs in the temperature range of 900÷1200 °C on n-Si samples doped with molybdenum during growth was studied. The n-Si<Mo> wafers were thoroughly acid-peroxide washed before heat treatment (samples of group I). Annealing was carried out in quartz boats in a tube in air.

The technique for fabricating diode structures and measuring and processing DLTS spectra is described in detail in [15-16]. For the experiments, we used n-Si doped with molybdenum in the process of growing from a melt, with specific resistance ρ = 10–100 Ohm·cm and orientation in the <111> direction.

Measurements of the DLTS spectra of initial samples of silicon doped with molybdenum during growth from a silicon melt showed that no deep levels are observed.

Figure 2 shows the DLTS spectra of silicon samples doped with molybdenum when grown from a melt and subjected to high-temperature treatment in the temperature range of 900–1200°C for 2 hours, followed by rapid cooling (samples of group I and group II).

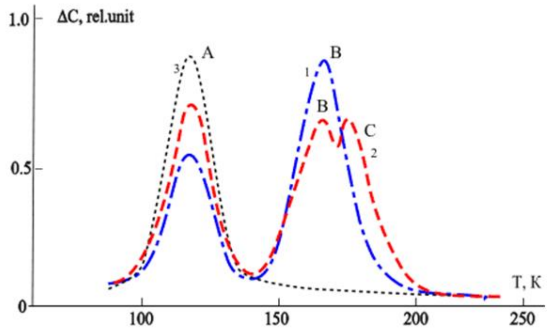

Fig.2. *Typical DLTS spectra of n-Si samples doped with Mo during growth and subjected after HTO at 1200°C (curve 1 - samples of group I, curve 2 - samples of group II.) and control heat-treated samples of n-Si (curve 3)*

An analysis of the measured DLTS spectra shows that the HTA of the n-Si<Mo> samples leads to the formation of known heat treatment defects with a level of E_C – 0.20 eV (peak A) and activation of Mo atoms with the formation of DL with E_C – 0.29 eV (peak B). It should be noted that, in some samples, insufficient cleaning of the surface of n-Si<Mo> samples before HTA (samples of group II) leads to the appearance of a new DL E_C – 0.33 eV (Fig. 2, curve 2, peak C) in a noticeable concentration. Comparison of the DLTS spectra of samples that underwent heat treatment in the range of 900–1200°C (Fig. 2, curve 2, peaks A and B) showed that the efficiency of the formation of the E_C - 0.33 eV level depends on the treatment temperature and the degree of surface cleaning before HTA. It has been established that the appearance of this DL occurs synchronously with a decrease in the concentration of the molybdenum level E_C - 0.29 eV (Fig. 2, curve 2, peak B).

As we know [15], the process of operation of semiconductor devices is accompanied by their heating to 100 °C, and sometimes up to 200°C. In this connection, it was of interest to investigate the effect of low-temperature annealing (LTA) on the properties of deep levels in molybdenum-doped silicon.

Isochronous and isothermal annealing of n-Si<Mo> samples was carried out in the temperature range 100÷400 °C in air with subsequent cooling in water. Before and after each annealing cycle, the concentration and other parameters of each deep level were determined separately.

Measurements of the DLTS spectra of n-Si doped with molybdenum during growth and subjected to HTA in the samples of group I Fig. 3 (curve 1) showed that low-temperature treatment at T=100÷400 °C does not lead to a noticeable change in the DL parameters and their concentration, but in n-Si doped with molybdenum during growth and subjected to HTA in the samples of group II in Fig. 3 (curve 2), with additional LTA, the energy spectrum of deep levels is transformed. As can be seen from Fig. 3 (curve 3), the concentration of the level E_C - 0.33 eV (peak C) stimulated by HTA, as a result of LTA at 300°C for 2 hours, noticeably decreases (curve 3) and with a further increase in the duration of treatment, it is completely annealed (curve 4). The analysis of the DLTS spectra showed that the annealing of the DL E_C - 0.33 eV is accompanied by an increase in the level concentration E_C - 0.29 eV. The parameters of the DL, E_C - 0.33 eV, and the change in its concentration with LTA are similar to the behavior of the Fe-Au complex, which was reported in [16]. An additional argument in favor of identifying a center with a level of E_C - 0.33 eV as a Fe-Mo complex can also be the fact that the efficiency of its formation depends on the HTA temperature and the degree of sample purification before HT. It is very likely that the source of Fe is the surface of the n-Si<Mo> samples that was not sufficiently cleaned before HTA.

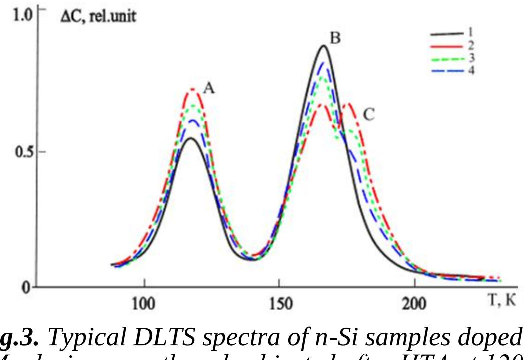

Fig.3. *Typical DLTS spectra of n-Si samples doped with Mo during growth and subjected after HTA at 1200°C (curve 1 - samples of group I, curve 2 - samples of group II) and n-Si<Mo> after HTA + LTA (curves 3 and 4).*

It is also possible, that Fe atoms got into silicon during the growth process and, upon subsequent slow cooling, passed into an inactive state, while HTA at 1200°C activates these atoms, which may be responsible for the formation of DL E_C - 0.33 eV. The assumption about the connection of this DL with the Fe–Mo impurity pair is also supported by synchronous changes in the concentration of levels E_C–0.29 eV; these changes are almost equal and opposite to changes in the concentration of DL E_C–0.33 eV.

It is likely that the formation of the proposed Fe-Mo complex leads to a decrease in Fe atoms in the electroactive state and, conversely, the decomposition of the Fe-Mo complex at temperatures T ≥ 300°C leads to a corresponding increase in the concentration of molybdenum levels.

To test the assumptions made, experiments were performed with special doping of n-Si<Mo> samples with iron. Alloying was carried out in the temperature range of 900÷1200°C for 2 hours in an open pipe in air from a soldered iron layer, followed by rapid cooling.

The results of capacitive measurements showed that these samples also exhibit DL E_C – 0.33 eV, and the efficiency of its formation increases with an increase in the diffusion temperature of Fe in Si and is much higher than in n-Si<Mo> samples subjected to HTA at the same processing temperature.

The annealing kinetics of the level E_C - 0.33 eV introduced into n-Si<Mo> both by iron diffusion and by HTA is the same. These results confirm the assumption about the relation between the DL E_C – 0.33 eV and the impurity pair of molybdenum with iron in silicon.

Conclusion. Thus, the analysis of the obtained results shows that the HTA in the range of 900–1200°C, followed by rapid cooling of the n-Si samples doped with Mo during growth, leads to the activation of Mo atoms with the formation of a deep level of E_C-0.29 eV. In n-Si<Mo> samples, there is also a new DL E_C - 0.33 eV, which is characterized by thermal instability; its formation or annealing is accompanied by synchronous changes in the concentration of the molybdenum level.

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REZYUME. Bu maqolada molibden atomlari bilan legirlangan Si da nuqsonli markazlarning hosil bo‘lish jarayonlari sig‘imli spektroskopiya usullari yordamida o‘rganildi.

Molibden atomlarining kremniyga diffuziya bilan kiritilishi n-Si<Mo>da E_C–0,20 eV va E_C–0,29 eV bo‘lgan chuqur sathlari va elektron tutilish kesimlari σ_n = 2•10-17 sm^2 va $\sigma_n = 4•10^{-16}$ cm^2 bo‘lgan nuqson markazlarining hosil bo‘lishiga olib kelishi ko‘rsatilgan. p-Si<Mo> namunalarida ionlanish energiyasi E_V+0,35 eV va kovakni tutib olish kesimi $\sigma_p = 7•10^{-15}$ sm^2 bo‘lgan bitta chuqurlik darajasi aniqlandi.

РЕЗЮМЕ. В статье рассматриваются методами емкостной спектроскопии исследованы процессы образования дефектных центров в кремнии, легированном молибденом. Показано, что диффузионное легирование атомов молибдена в кремний приводит к образованию дефектных центров с глубокими уровнями E_C–0,20 эВ и E_C–0,29 эВ с сечениями захвата электронов σ_n = $2•10^{-17}$ $см^2$ и σ_n = 4. •10^{-16} $см^2$ в n-Si<Mo>. В образцах p-Si<Mo> обнаружен один глубокий уровень с энергией ионизации E_V+0,35 эВ и сечением дырочного захвата $\sigma_n = 7\cdot10^{-15}$ $см^2$.

SUMMARY. The processes of the formation of defect centers in Si doped with molybdenum have been investigated using the methods of capacitive spectroscopy. It is shown that the diffusion introduction of molybdenum atoms into silicon leads to the formation of defect centers with deep levels E_C–0.20 eV and E_C–0.29 eV with electron capture cross sections $\sigma_n = 2\cdot10^{-17}$ cm^2 and $\sigma_n = 4\cdot10^{-16}$ cm^2 in n-Si<Mo>. In the p-Si<Mo> samples, one deep level with an ionization energy E_V+0.35 eV and a hole capture cross section $\sigma_p = 7\cdot10^{-15}$ cm^2 was found.

УДК: 316.7:008.2

РАҚАМЛИ ДАВЛАТ СТРАТЕГИЯСИНИ ШАКЛЛАНТИРИШДА МИЛЛИЙ ХАВФСИЗЛИКНИ ТАЪМИНЛАШ

Н.О.Сатторов – *мустақил изланувчи*

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Таянч сўзлар: рақамли дипломатия, геосиёсат, кибертерроризм, ижтимоий тармоқлар, халқаро муносабатлар, интернет майдони, тармоқ марказийлиги, «юмшоқ куч», ташқи сиёсат.

Ключевые слова: цифровая дипломатия, геополитика, кибертерроризм, социальные сети, международные отношения, интернет-пространство, сетевая центральность, «мягкая сила», внешняя политика.

Key words: digital diplomacy, geopolitics, cyberterrorism, social networks, international relations, Internet space, network centrality, "soft power", foreign policy.

Кириш. Замонавий глобал ахборот жамиятини ташкил этувчи ахборот-коммуникация технологиялари ва Интернетнинг жадал ривожланиши чегара билмайди. Натижада жамият ва давлатнинг барча соҳаларига, шу жумладан, халқаро сиёсатга ўзгарувчан таъсир кўрсатади. Шу билан бирга, Интернет таъсири сезиларли дара-