Among them, Ordos had the largest growth with an increase of 0.4583 and an annual growth rate of 0.0286%. The overall development of system coupling coordination degree is good, and the spatial evolution pattern shows that there are obvious spatial differences among cities. From 2008 to 2013, Hohhot, Baotou Ordos and Ulanqab all showed a growth trend, and reached moderate coordination, showing a good development trend. From 2013 to 2018, Hohhot and Ordos continued to show an increasing trend, and at the same time reached a good coordination state, and have now developed into the first echelon of HBOUUA. Both Baotou and Ulanqab showed a downward trend, and Baotou fell faster, and both were in a moderate coordination state. Although Hohhot and Ordos have been in a good coordination state, there is still a big gap between them, which also indicates that Hohhot and Ordos still have more space for development in the future.

Conclusions. The urbanization process of HBOUUA continues to advance rapidly, and the contradiction between population, resources, environment and economic system becomes increasingly acute. This paper adopts the method of system theory to construct the comprehensive evaluation index system of population, resources, environment and economy. Based on the minimum information entry weight method, coupling degree, coupling coordination degree and other models, the comprehensive development level of the HBOUUA a system from 2000 to 2019, the temporal evolution characteristics of coupling coordination degree and the spatial evolution pattern of coupling coordination degree were deeply discussed. The coupling coordination degree of Ordos improved the most, followed by Hohhot, and attained a good coordination state in 2018. The coupling coordination degree of Baotou and Ulanqab has a weak ability to upgrade, and has been in a moderate coordination state for a long time. The coupling coordination degree of Baotou and Ulanqab still has a large space for improvement in the future.

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РЕЗЮМЕ. Мақолада айтилишича, аҳоли, ресурслар, атроф-муҳит ва иқтисодий тизимнинг уйғунлиги ва мувофиқлаштирилган ривожланиши минтақавий сифат ривожланишининг муҳим қисмидир. ҲБОУУАда аҳоли-ресурслар-атроф-муҳит-иқтисодиёт тизимининг уланиш даражаси ишга тушириш босқичидан юқори даражадаги уланиш даражасига кўтарилди ва алоқани мувофиқлаштириш даражаси бироз тартибсизликдан ўртача мувофиқликка ўзгарди.

РЕЗЮМЕ. В статье говорится, что сопряжение и скоординированное развитие населения, ресурсов, окружающей среды и экономической системы является важной частью регионального качественного развития. Степень связанности системы население-ресурсы-окружающая среда-экономика в HBOUUA повысилась со стадии обкатки до высокого уровня связи, а степень координации связи изменилась с легкой неупорядоченности на умеренную согласованность.

SUMMARY. This article states that the coupling and coordinated development among population, resources, environment and economic system is the important part of regional high quality development. The coupling degree of population-resources-environment-economy system in HBOUUA rised from running-in stage to high level coupling, and the coupling coordination degree changed from mild disorder to moderate coordination.

DIFFUZIYA USULI BILAN LEGIRLANGAN KREMNIYDA RUX VA SELEN ATOMLARINI ELEKTROFIZIK XUSUSIYATLARINI TAHLIL QILISH

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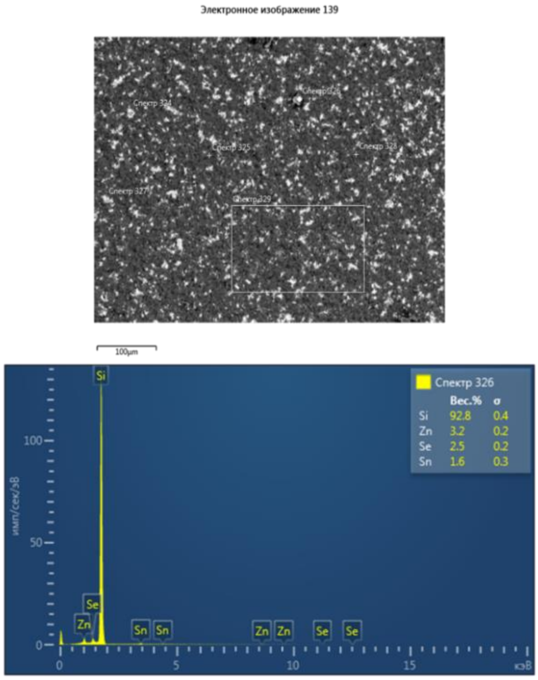
Tayanch so'zlar: diffuziya, rentgen fazasi tahlili, kremniy, selen, rux, relyef, birikmalar, nanokristal, refleks, klaster, tuzilishi.

Ключевые слова: диффузия, рентгенофазовый анализ, кремний, селен, цинк, рельеф, соединения, нанокристалл, рефлекс, кластер, структура.

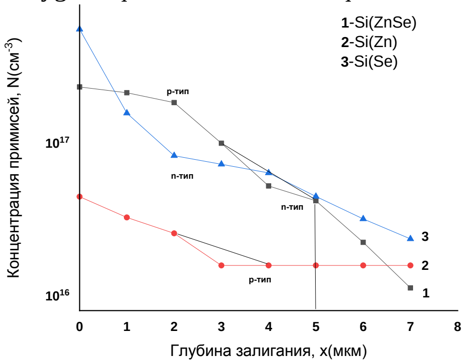
Key words: diffusion, X-ray phase analysis, silicon, selenium, zinc, relief, compounds, nanocrystal, reflex, cluster, structure.

Zamonaviy mikro va nanoelektronika rivoji energiya tejovchi xususiyatlarga va yangi funksiyalarga asoslangan yangi materiallar va qurilmalarni yaratishni talab qiladi. Shu nuqtayi nazardan, nanostruktiv kremniy, begona atomlar bilan legirlangan kremniy katta qiziqish uyg'otadi. Bunday materiallarni turli xil usullar bilan atomlar klasterlarini shakllantirish yo'li bilan olish mumkin, ammo tadqiqotlar shuni ko'rsatdiki, olingan materiallar zamonaviy nanoelektronikada muammolarni to'liq hal qilishga imkon bermaydi. Bu, asosan, yuqori konsentratsiyaga bog'liq emas, shuningdek, konsentratsiyani va kremniydagi aralash nanoklastlarning tarkibini nazorat qilish qobiliyati emas. Shuning uchun, kremniy elementar panjarasida II va VI guruh elementlarini o'z ichiga olgan ikkilik klasterlarning yangi turining shakllanishi katta qiziqish uyg'otadi. Adabiy ma'lumotlardan ma'lum bo'lishicha, kremniydagi bu ikkilik atomlar yuqori eruvchanlikka ega (N - 10^{20}– 10^{21}cm^{-3}). Alohida holatda bu atomlar kichik donor va qabul qiluvchi darajalarni yaratadi, kremniy esa o'z navbatida valentlik zonasida o'tkazuvchanlik zonasida qo'shimcha elektronlar hosil qiladi [1]. Shu nuqtayi nazardan, ushbu tadqiqotning maqsadi, kremniy yuzasida olingan diffuziya qatlami $(Si_2)_{1-x}(ZnSe)_x$ rentgenofaza tahlillari yordamida sirt holatini o'rganishdir. Tuzilmalar tasvirlangan texnologiya cheklangan hajmi diffuziya tomonidan olingan. Diffuziya qatlami$(Si_2)_{1-x}(ZnSe)_x$ KEF–100 markali kremniyga asoslangan bo'lib, (111) kristalografik yo'nalishi va 20 mm diametri bilan olingan.Kremniy asosidagi qatlamlar 5 mm qalinligi bilan n-o'tkazuvchanlik turiga ega edi. Kremniy yuzasining elementar tarkibini aniqlash uchun "Jeol" JSM 5910 LV-Japan markasining rentgen mikro-analizatorida namunalar ishlatilgan ushbu tadqiqot natijalari diffuzion qatlam $(Si_2)_{1-x}(ZnSe)_x$ hajmidagi komponentlarning taqsimlanishi x = 5 mm chuqurlikka o'zgarib borishini ko'rsatdi [2]. Shakl bo'yicha.1. diffuziya qatlamining chuqurligi bo'yicha komponentlarni taqsimlash profili berilgan. Ko'rib turganingizdek, diffuziya qatlami turi $(Si_2)_{1-x}(ZnSe)_x$ da, ZnSe molekulyar birikmasining tarkibi nemonotonik tarzda o'sib boradi, bu ZnSe molekulalariga nisbatan noaniqligi bilan izohlanadi. Bundan tashqari, ZnSe tarkibi tez o'sib, sirtdan x =5 mm maksimal qiymatga yetadi. Qatlamlarning o'sishi cheklangan hajmda amalga oshirilganligi sababli, diffuziya qatlamining o'sishi bilan ZnSe b molekulalarining kontsentratsiyasi kamayadi, bu esa hosil bo'lgan yangi qattiq fazada ZnSe ning molar fraktsiyasining bosqichma-bosqich pasayishiga olib keladi.



1-rasm-Diffuziyadan keyin kremniy yuzasida rux va selen atomlarining rentgent mikroanalizatoridan olingan natijari tahlili. (T=300 K)

Bu nuqson atomlar tufayli o'zi atrofida dissotsilanish uchun alohida atom davriy panjara topilgan bo'lsa, shuningdek, panjara bir nuqson bo'lgan elektr salohiyatini yaratadi. Rux va selen atomlari orasidagi elektroneytral molekulalarning hosil bo‘lishida kremniyda taqiqlangan zonasida hech qanday energiya darajasi yaratilmaydi, ya'ni qo'shimcha zaryad tashuvchilar paydo bo'lmaydi [3]. Ayniqsa, molekulalarning shakllanishi bu nuqson atomlar yuqori konsentratsiyasi mavjudligini hisobga oladi. Molekulyar birikmalar holatida, begona atomlarning energiya salohiyati bir-biri bilan himoyalangan, shuning uchun bunday holatlarda nuqson atomlar orasidagi Kulon bog’lanishlari hisobga olish kerak. Ushbu mexanizmlar ion aloqalarining shakllanishi elektroneytral molekulalarning shakllanishida rag'batlantiruvchi omil bo'lib, eng yuqori termodinamik muvozanat holatini ta'minlaydi [4]. Shuning uchun ma'lum sharoitlarda rux va selen atomlari molekulyar birikmalarning shakllanishida ishtirok etishi mumkin. Bunday elektron neytral molekulalarning hosil bo'lishida yangi elementar panjaralar $(Si_2)_{1-x}(ZnSe)_X$. bunday ikkilik elementar panjaralarning kontsentratsiyasi va taqsimlanishi asosan diffuziya, ya'ni rux va selen aralashmalari atomlarining kremniyga tarqalishi harorati va vaqti bilan aniqlanadi.



2-rasm-Diffuziyadan so’ng rux va selen atomlarini kremniyda konsentratsiya taqsimoti

Rasm bo'yicha (2-rasm) rux va selen aralashmalarning kremniyga kontsentratsion taqsimlanishini shuni ko'rsatadiki, ular alohida-alohida va bir vaqtning o'zida diffuziya bilan legirlangan. Olingan natijalarning tahlilidan kelib chiqqan holda, rux va selen aralashmalarning eruvchanligi farqli o'laroq, kremniy diffuziya usuli bilan alohida-alohida legirlangan. Bir vaqtning o'zida birikma bilan rux atomlarining eruvchanligi kattalashadi. Bu bir vaqtning o'zida rux va selen atomlari legirlangan kremniyda diffuziya usuli bilan ZnSe tipidagi molekulyar birikmani ko'rsatadi [5].

Rux va selen aralashmalarning diffuziya usuli bilan legirlash kremniyda texnologiyasi ishlab chiqilgan va olingan materiallar fundamental fotoelektrik va optik xususiyatlarini nazorat qilish imkonini beradi. ZnSe ikkilik birikmalar kontsentratsiyasini yaratish va nazorat qilish qobiliyatini ko'rsatdi o'rganish tahlili shuni ko'rsatdiki, kremniy olingan ikki tomonlama birikmalar turi $(Si_2)_{1-x}$ $(ZnSe)_x$ yarimo'tkazgichli lazerlar va quyosh elemnetlarini ishlab chiqish imkonini beradi.

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REZYUME. Maksimal samaradorlik va barqaror elektr parametrlarga ega bo'lgan samarali fotoelementlarni ishlab chiqish uchun yarimo'tkazgichli materiallarni olishning hozirda mavjud texnologik usullari deyarli o'z chegarasiga yetdi. Fotoelementlarning asosiy parametrlarini yanada oshirish uchun yarimo'tkazgich materiallarining noan'anaviy xususiyatlaridan foydalanish kerak yoki kashf etilgan yangi fizik hodisalarni talab qiladi. Mikro- va optoelektronikaning zamonaviy rivojlanishi yangi materiallar, shu jumladan A^3B^5 va A^2B^6 yarimo'tkazgich birikmalari asosidagi materiallar sinteziga qiziqish uyg'otmoqda. Bunday birikmalarning tarmoqli bo'shlig'i va panjara konstantasi ma'lum chegaralar ichida o'zgarib turadi, chunki bunday materiallarning asosiy parametrlariga ta'sir qiluvchi nopoklik atomlarining kontsentratsiyasiga bog'liq. Ular asosida elektr va fotoelektrik xossalari keng bo‘lgan yarimo‘tkazgichli materiallar hamda kvant nuqtali super panjaralarni sintez qilish mumkin.

РЕЗЮМЕ. Существующие в настоящее время технологические методы получения полупроводниковых материалов для разработки эффективных фотоэлементов с максимальным КПД и стабильными электрофизическими параметрами практически достигли своего предела. Для дальнейшего повышения основных параметров фотоэлементов необходимо использовать нетрадиционные свойства полупроводниковых материалов или требует обнаруженные новых физических явления. Современное развитие микро- и оптоэлектроники вызывает интерес к синтезу новых материалов в том числе и на основе полупроводниковых соединений A^3B^5 и A^2B^6. Поскольку ширина запрещенной зоны и постоянная решетки таких соединений меняются в определенных пределах, в зависимости от концентрации примесных атомов которые влияет на фундаментальных параметрах таких материалов. На их основе можно синтезировать полупроводниковые материалы с широким диапазоном электрических и фотоэлектрических свойств, а также сверхрешетки с квантовыми точками.

SUMMARY. The currently existing technological methods for obtaining semiconductor materials for the development of efficient photocells with maximum efficiency and stable electrical parameters have almost reached their limit. To further increase the main parameters of photocells, it is necessary to use non-traditional properties of semiconductor materials or requires discovered new physical phenomena. The modern development of micro- and optoelectronics arouses interest in the synthesis of new materials, including those based on A^3B^5 and A^2B^6 semiconductor compounds. Since the band gap and lattice constant of such compounds vary within certain limits, depending on the concentration of impurity atoms, which affects the fundamental parameters of such materials. Based on them, it is possible to synthesize semiconductor materials with a wide range of electrical and photoelectric properties, as well as superlattices with quantum dots.

QUYOSH BATARIYASINING SAMARADORLIGI VA BOSHQA PARAMETRLARGA ALOQADORLIGI

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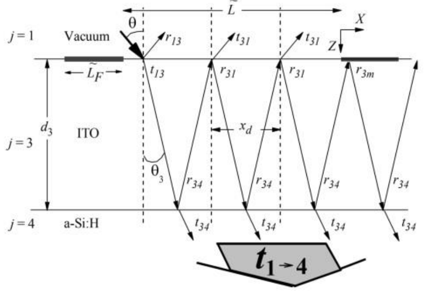
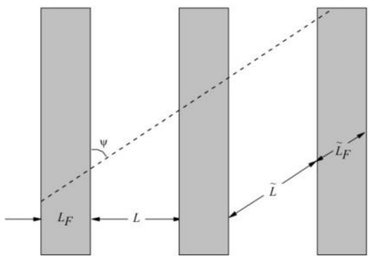
Tayanch so'zlar: SC-quyosh elementi(Solar cell), AM-Atmosfera massasi, FF-to'ldirish faktori, VAX-volt- amper-xarakteristka.
Ключевые слова: СК-солнечный элемент, АМ-масса атмосферы, FF-фактор заполнения, VAX-вольтамперная характеристика.
Key words: SC-solar cell, AM-atmospheric mass, FF-fill factor, VAX-volt-ampere-characteristic.

Har xil vaqtlarda *a-Si:H* quyosh batareyasining samaradorligi va boshqa parametrlarini hisoblash uchun, Ularga yorug'lik tushishini turli hil burchaklari θ va "finger-plane of incidence" mos keluvchi burchaklar Ψ (1 va 2 rasmlarga qarang), yoki quyosh batareyasi parametrlarini o'rtacha har xil vaqt oralig'ida hisoblash uchun, biz quyoshning ixtiyoriy vaziyatlari uchun quyosh spektrini bilishimiz kerak, masalan atmosfera massasini o'zgarishi Christian Gueymardning tomonidan qilingan ish ma'lumotlaridan foydalanib buni amalga oshirish mumkin [17]. Amaldagi FORTRAN dasturida, quyosh batareyasi samaradorligi va boshqa parametrlarni faqat AM0 va AM1,5 nurlanish shartlari uchun nurlanishning quyosh batareyasi yuzasiga normal tushish holatida hisoblash mumkin. Shunga qaramay, umumiy formula quyida yozilgan bo'lib, ular qiya tushgandagi nurning mumkin bo'lgan $s - va\, p -$ qutublangan qismlarini hisobga oladi.



1-rasm



2-rasm

Qisqa tutashuv tokening umumiy zichligi, yuqorida aytib o'tlganidek 4- rasmda ko'rsatilga quyosh spektrlarining $I(\lambda)$ g'oyib bo'ladigan kichik (masalan deyarli monoxromatik)qisimlarining ulushlarini yig'ish yo'li bilan hisoblash mumkin.

$$j_{SC} = \frac{1}{2}\int_{\lambda_m}^{\lambda_0} \mathfrak{I}(\lambda)[(j_{e,SC}^{\lambda,s} + j_{h,SC}^{\lambda,s}) + (j_{e,SC}^{\lambda,p} + j_{h,SC}^{\lambda,p})]d\lambda \quad (1)$$

Buyerda λ_m – quyosh spektridagi eng qisqa to'lqin uzunligi, unda quyosh batareyasining faol mintaqasiga yorug'lik kirib borishi hali ham davom etadi (hisoblashlarda 4.0 energiyaga mos keladigan $\lambda_m = 0.31\mu m$ qiymati ishlatilgan *a-Si:H*ning 4,0 eVga yaqin energiyadagi o'tkazuvchanligi 3-rasmga qarang), λ_0 bu *a-Si:H* dagi taqiq soha E_g ga mos keladigan to'lqin uzunligi. $\mathfrak{I}(\lambda) = \frac{I(\lambda)}{\hbar\omega} = I(\lambda)\lambda/2\pi\hbar c$ fotonlarning spectral zichligi, birlik maydonga tushishi, $j_{e,SC}^{\lambda,s(p)} va\, j_{h,SC}^{\lambda,s(p)}$ λ to'lqinuzunli monoxramatik nurdan qisqa tutashuv oqimiga ikkinchi va uchinchi qismlardagi elektronlar va teshiklarning ulushlari ko'rib chiqilgan.

$$g^{p(s)}(z,\lambda) = \frac{(1\text{-}m)\alpha_\lambda I_0^{p(s)}(\lambda)T_{1\to4}^{p(s)}(\lambda)}{1 - R_{4\to1}^{p(s)}(\lambda)R_{4\to5}^{p(s)}(\lambda)\exp\left[-2\alpha_\lambda(d_p + d + d_n)\right]}\times \quad (2)$$

$$\times\{\exp(-\alpha_\lambda z) + R_{4\to5}^{p(s)}(\lambda)\exp\left[-2a_\lambda(d_p + d + d_n)\right]\exp(\alpha_\lambda z)\}$$

$$A_{1,n}^{\lambda,p(s)} = \frac{(1-m)\alpha_\lambda I_0^{p(s)}(\lambda)T_{1\to4}^{p(s)}(\lambda)}{1-R_{4\to1}^{p(s)}(\lambda)R_{4\to5}^{p(s)}(\lambda)exp[-2\alpha_\lambda(d_p+d+d_n)]} * \frac{L_n^2/D_n}{1-(\alpha_\lambda L_n)^2},$$

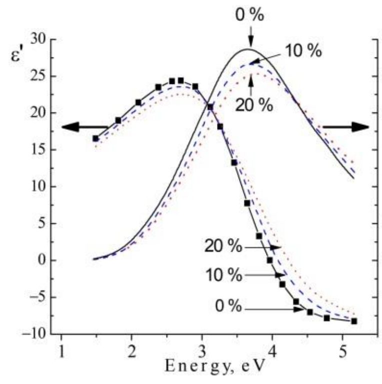
$$A_{2,n}^{\lambda,p(s)} = A_{1,n}^{\lambda,p(s)}R_{4\to5}^{p(s)}(\lambda)exp\left[d_p + d + d_n\right]. \quad (3)$$

va

$$A_{1,p}^{\lambda,p(s)} = \frac{(1-m)\alpha_\lambda I_0^{p(s)}(\lambda)T_{1\to4}^{p(s)}(\lambda)}{1-R_{4\to1}^{p(s)}(\lambda)R_{4\to5}^{p(s)}(\lambda)exp[-2\alpha_\lambda(d_p+d+d_n)]} * \frac{L_p^2/D_p}{1-(\alpha_\lambda L_p)^2},$$

$$A_{2,p}^{\lambda,p(s)} = A_{1,p}^{\lambda,p(s)}R_{4\to5}^{p(s)}(\lambda)exp\left[-2\alpha_\lambda(d_p + d + d_n)\right]. \quad (4)$$

formuladagi $I_0^{p(s)}(\lambda)$ (1)- tenglamadagi integral ifodasi uchun oqim zichliklarini $j_{e,SC}^{\lambda,s(p)} va\, j_{h,SC}^{\lambda,s(p)}$ hisoblash orqali foydalanish mumkin. $I_0^{p(s)}(\lambda)$ning o'rniga (2), (3), va (4) dagi yorug'likning s- qutublangan qismi uchun intensivligi $\mathfrak{I}(\lambda)/2$ va yorug'likning p-qutublangan qismi uchun bir xil intensivligi $\mathfrak{I}(\lambda)/2$ bo'lib ko'rinadi (1)da.



3-*rasm*