Rentgen trubkasining rejimi 70kV, 4mA etib olindi. Rentgen nuri bilan ta`sir etib nurlantirilgandan keyin kristall 9K/min doimiy tezlik bilan qizdiriladi va shu qizdirish davomida issiqlik energiya ta`sirida yuzaga keladigan termolyuminessensiyaning o`zgarishi grafik chizadigan qurilma yordamida yozib olinadi,1-rasm. Bu rasmda temperaturaning 125-200K intervalida $LiBaWF_9$ kristallining termolyuminessensiya grafigi kuzatilib uning maksimumlari 140 va 157K larga mos keladi. 140K dagi termolyuminessensiya maksimumining intensivliligi 157K dagi termolyuminessensiya maksimumidan intensivliligi ikki barobar kichik bo`lishini ko`rish mumkin.

Termolyuminessensiya metodi bu juda ham sezgir metodlardan biri bo`lib bu metod yordamida olingan grafiklardan foydalanib nur chiqaruvchi markazlarning aktivatsiya (faollashtirish) energiyasini aniqlash mumkin. Uning uchun adabiyotlardan ma`lum quyidagi formulalardan foydalanamiz.

$$E = 2\frac{kT_{max}^2}{\delta}$$

bu yerda k – Boltsman doimiysi, T_{max} – termolyuminessensiya grafigining maksimumlariga mos keladigan temperatura, $\delta -$ termolyuminessensiya maksimumlarining yarim balandliligi eniga mos keladigan temperatura. Bu formula yordamida $LiBaWF_9$ kristallining termolyuminessensiya grafigining 140K ga mos keladigan maksimumuning aktivatsiya (faollashtirish) energiyasi 0,19 eV ga mos keladi, 157K dagi maksimumga mos keladigan aktivatsiya (faollashtirish) energiyasi 0,22eV ga to`g`ri keladi bu energetik tomondan bir-biriga yaqin bo`lga nur chiqaruvchi markazlar ekanligini korish mumkin.

[1-4] ilmiy ishlardagi keltirilgan ma'lumotlarga asoslanib gidrotermal metodi bilan o'stirilgan $LiBaWF_9$ kristalida Rentgen nuri bilan ta`sir etilgandan keyin 77 – 300K temperatura intervalida paydo bo'lgan termolyuminessensiya maksimumlari $F_2^-(V_k)$ markazda tutilib qolgan elektronlarning rekombinatsiyasi natijasida yuzaga keladi va $(V_k + e^-)$ avtolokallashgan eksiton bilan bog̃liq deb hisoblaymiz.

Xulosa. Gidrotermal metodi bilan o`stirilgan $LiBaWF_9$ kristallida rentgen nuri bilan ta`sir etilgandan keyin termolyuminessensiya paydo bo`ladi va uning grafigining maksimumlari 140, 157K larga mos keladi, shuningdek bu maksimumlarga mos keladigan aktivatsiya (faollashtirish) energiyasi 0.19, 0.22eV ga teng.

Gidrotermal metodi bilan o`stirilgan $LiBaWF_9$ kristalli lyuminaforllarga qo`yiladigan talablarga to`la javob beradi, shuning uchun bu kristallni kompyuterlik tomografiyada lyuminafor sifatida qo'llash mumkin.

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REZYUME. $LiBaWF_9$ kristallining termolyuminessensiyasini tadqiq qilindi.

РЕЗЮМЕ. Исследована термлюминесценциз кристаллов $LiBaWF_9$.

SUMMARY. The thermoluminescence of $LiBaWF_9$ crystals has been studied.

PULSE PHOTON PROCESSING OF A THIN-FILM Si/Mg/Si/Sitall System

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Tayanch so'zlar: tez issiqlik bilan ishlov berish (TIB), magniy silicidi, impulsli fotonik ishlov berish, geterostruktura, Si/Mg/Si/sitall tizimi.

Ключевые слова: быстрая термическая обработка (БТО), силицид магния, импульсная фотонная обработка, гетероструктура, система Si/Mg/Si/ситалл.

Key words: rapid heat treatment (RHT), magnesium silicide, pulsed photonic treatment, heterostructure, Si/Mg/Si/sitall system.

The fundamental electronic properties of Mg_2Si single crystals have been widely studied theoretically and experimentally [1]. Since magnesium has a low adhesion coefficient to the silicon surface and a high vapor pressure, most of the proposed methods for the formation of Mg_2Si do not make it possible to obtain films of sufficiently high quality. The main method for the formation of thin Mg_2Si films of stoichiometric composition on silicon is molecular beam epitaxy. However, the substrate temperature during growth cannot exceed 200°C, which ensures the formation of only polycrystalline Mg_2Si films with a sufficiently developed surface relief. For the creation of silicide-silicon heterojunctions and the construction of new semiconductor devices, this is not a sufficient condition [2-5]. Therefore, it is of undoubted interest to develop new methods for the formation of Mg_2Si films on silicon, in which higher temperatures can be used to improve the crystalline quality of the films.

The method of irradiating silicon samples with a magnesium film by a pulsed laser led to the formation of films that are a mixture of Mg_2Si and polycrystalline silicon, and in which amorphous regions may be present [5]. In this work, for the formation of magnesium silicide, a method was used on the basis of which the optimal temperatures and pulse durations for the synthesis of magnesium silicide (RHT) were determined. The choice of temperatures was carried out on the basis of the analysis of the state diagram of the magnesium-silicon system (Fig 1)

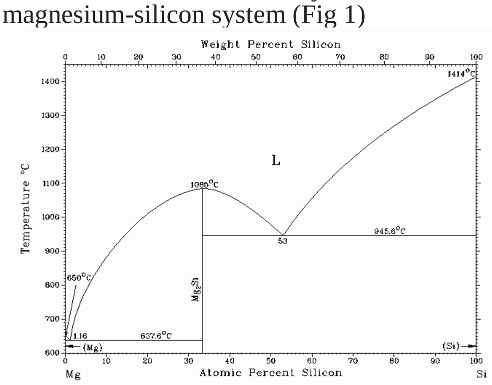


Fig 1-State diagram of the magnesium-silicon system

A thin-film system Si-Mg-Si on glass-ceramic was formed by the method of electron-beam deposition. The ratio of layer thicknesses in the Si-Mg-Si multilayer composition, optimal for the formation of Mg_2Si silicide, was 20 nm-100 nm-20 nm.

Heat treatment regimes significantly depend on the energy density and duration of treatment. There are three most important cases [6]: - adiabatic mode (10^{-10}-10^{-6} s) is realized in the range of short light pulses; - the heat flow regime (10^{-6}–10^{-2} s) is realized when, during the time of pulsed photon processing, the area of diffusion heat redistribution becomes larger than the thickness of the layer in which radiation is absorbed, but does not extend to the entire thickness of the sample [6]; In the heat balance mode (10^{-2} s and more), it is realized when the thermal front reaches the non-irradiated side of the sample and equalizes the temperature profile along the thickness

Increasing the pulse duration above 0.1 s leads to almost uniform heating of the plate over its entire thickness, the temperature difference does not exceed 1^0C [6]. This admits that when performing temperature calculations under such RHT regimes, the temperature over the thickness of the plate can be considered constant.

The promise of pulsed photon processing in the heat balance mode is associated with uniform heating of the plate over the thickness, which ensures the absence of its deformations.

In such processing of a silicon wafer and silicon-based heterostructures using second pulses, one should take into account the heat loss due to radiation from the wafer itself. The process of heating the heterostructure with pulses of a second duration can be described under the following assumptions: - the radiation pulse has a rectangular shape; - before irradiation, the temperature of the heterostructure is constant throughout the volume; - there is no heat exchange between the plate and the substrate holder; - there are no temperature gradients along all coordinates.

The heating process of the structure under study can be described by the heat balance equation [5]

$$\rho c h \frac{dT}{dt} = (1-R)E - 2\varepsilon\sigma(T^4 - T_0^4) \quad (1)$$

where ρ - is the density of silicon, c- is the heat capacity of silicon, h- is the thickness of the structure, E- is the power density of the light flux incident on the structure, R- is the reflectivity, T_0- is the ambient temperature, t- is time, ε is the emissivity, σ- is Stefan-Boltzmann constant, T - temperature.

The elemental composition of the samples was studied using an energy-dispersive (EDS) microanalysis system mounted on a SEM 515 scanning electron microscope. This system includes a Si(Li) detector with an ultra-thin window cooled by liquid nitrogen, a computer, and the Genesis SEM Quant software package. ZAF software.

The measurements were carried out at different values of the accelerating voltage: from the minimum sensitivity threshold of the microanalysis system (6.4 kV) to the maximum value of the accelerating voltage equal to 30 kV. Rapid heat treatment was carried out on a UOLP-1M unit. In the UOLP-1M facility, silicon wafers are heated by radiation from three INP16/250 gas-discharge xenon lamps.

The setup consists of three power supplies for INP16/250 lamps, a control unit, a quartz irradiator, and a modernized chamber for annealing Si substrates in vacuum at Growth. Pres= 3 10^{-3} Pa, contactor block.

To ensure the reproducibility of technological results, the installation provides for automatic maintenance of a given level of energy exposure on the processed plate, regardless of fluctuations in the mains voltage and changes in the parameters of the lamps with their service life due to the introduction of feedback on the radiation of the lamps.

The reactor used to process the structures in vacuum was made of stainless steel. Xenon lamps placed inside the reactor are inserted into quartz tubes, the outer surface of which is coated with a diffusion reflective coating. The outer surface of the quartz reactor is also covered with a diffusion reflective coating, which practically does not change in the entire spectral range of radiation from xenon lamps with a reflection coefficient of 0.9. The diagram of the reactor is shown in Fig 2.

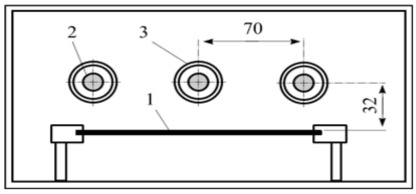


Fig 2 - Cross-section of the stainless steel reactor of the UELP-1M pulsed photon processing unit: 1 - processed silicon wafer, 2 - INP 16/250 lamps, 3 - quartz tube

The characteristic dependences of the temperature change on time in the modes studied by us are shown in Fig 3 a, b, c.

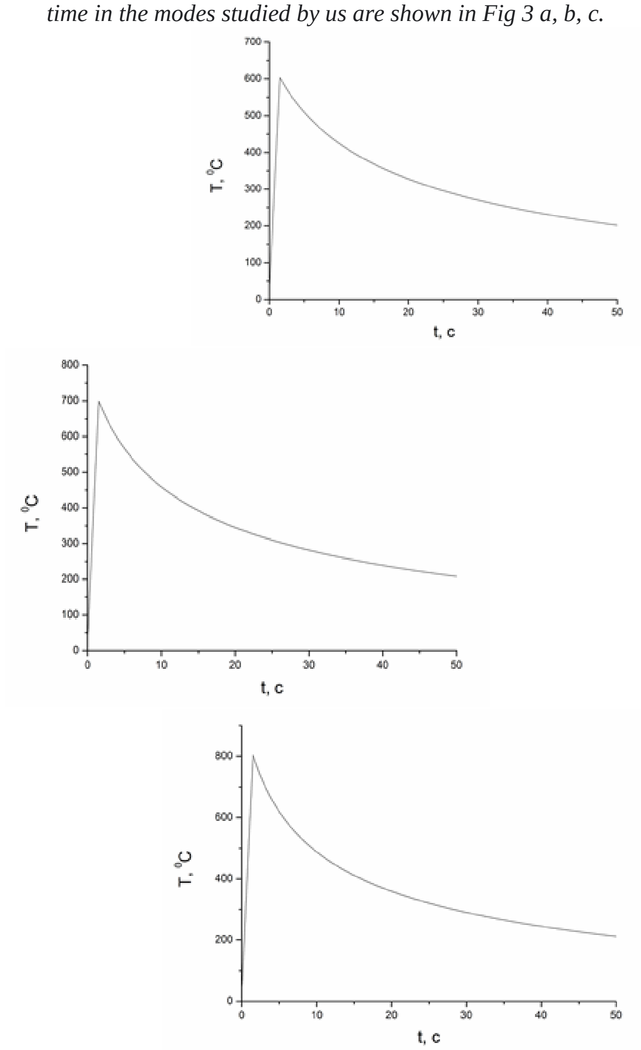
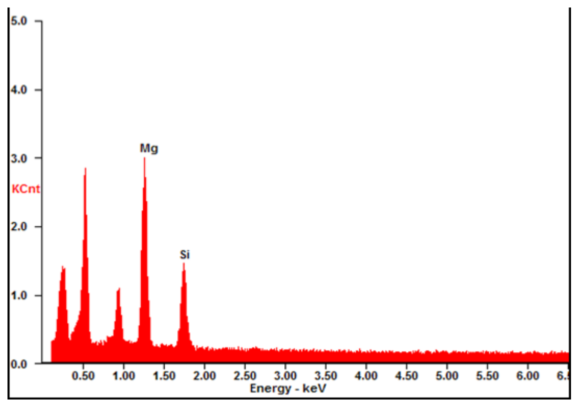


Fig 3. - Changes in sample temperature depending on time at an energy density of 288 J/cm² (a), 337.5 J/cm² (b) and 390 J/cm² (c) (pulse duration 1.5 s)

Fig 4.- shows the X-ray spectra and the results of microanalysis initial system Si/Mg/Si/sitall



Element	Wt, %	At, %	Z	A	F
MgK	35.46	38.83	1.0068	0.9871	1.0097
SiK	64.54	61.17	0.9963	0.9548	1.0000

Fig 4. - X-ray spectra and microanalysis results initial system Si/Mg/Si/sitall. where Wt is the weight content of the element, At is the atomic content of the element, Z, A, F are correction factors

X-ray diffraction studies of the elemental composition of the initial Si-Mg-Si systems on a SEM 515 scanning electron microscope with an attachment for microanalysis showed that the atomic ratio of Mg to Si was ~2/1 (Fig 4), which is optimal for the formation of the Mg_2Si magnesium silicide phase. The rest of the peaks belong to the elements that make up the glass-ceramic.

Dependence analysis shows that in all processing modes there is a sharp rise in temperature, and then its decline. It follows from the given data that at energy densities from 337.5 to 390 J/cm^2 temperatures are reached that are sufficient for the formation of magnesium silicide Mg_2Si.

As a result of the work, a technique for applying a three-layer silicon-magnesium-silicon composition on glass-ceramic substrates was developed. A computer simulation of the temperature change with time in the Si/Mg/Si/sitall system under pulsed photon treatment was carried out, on the basis of which the optimal temperatures and pulse durations for the synthesis of magnesium silicide were determined.

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REZYUME. Bu silicid-kremniy getero-birikmalarini yaratish va yangi yarimo'tkazgich qurilmalarini qurish uchun etarli shart emas. Shu sababli, kremniyda Mg_2Si plyonkalarini hosil qilishning yangi usullarini ishlab chiqish shubhasiz qiziqish uyg'otadi, bunda plyonkalarning kristallik sifatini yaxshilash uchun yuqori haroratlardan foydalanish mumkin. Ushbu ishda magniy silisidini hosil qilish uchun tezkor issiqlik bilan ishlov berish (TIB) usuli qo'llanildi. Buning asosida magniy silisidini sintez qilish uchun optimal haroratlar va impuls davomiyligi aniqlanadi.

РЕЗЮМЕ. Для создания гетеропереходов силицид-кремний и построения новых полупроводниковых приборов это не является достаточным условием. Поэтому представляет несомненный интерес разработка новых способов формирования пленок Mg_2Si на кремнии, в которых можно использовать более высокие температуры для повышения кристаллического качества пленок. В данной работе для формирования силицида магния использовали метод быстрой термической обработки (БТО) на основании которого определены оптимальные температуры и длительности импульса для синтеза силицида магния

SUMMARY. This is not a sufficient condition for creating silicide-silicon heterojunctions and building new semiconductor devices. Therefore, it is of undoubted interest to develop new methods for the formation of Mg_2Si films on silicon, in which higher temperatures can be used to improve the crystalline quality of the films. In this work, the rapid heat treatment (RHT) method was used to form magnesium silicide. on the basis of which the optimal temperatures and pulse durations for the synthesis of magnesium silicide are determined

VIET TEOREMASÍNAN PAYDALANÍP PARAMETRLI KVADRAT TEŃLEMELERDI SHESHIW USÍLLARÍ

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Tayanch soʻzlar: parametr, kvadrat tenglamalar, tenglamaning korenlari.

Ключевые слова: параметр, квадратные уравнения, корни уравнения.

Key words: parameter, quadratic equations, equation roots.

Bizge mektep matematika kurısınan keltirilgen hám tolıq kvadrat teńlemeler ushın Viet teoreması tómendegishe bolatuǵını belgili:

1. Keltirilgen $x^2+px+q=0$ kvadrat teńlemesi ushın Viet teoreması: $x_1+x_2=-p, \quad x_1\cdot x_2=q$

2. Tolıq $ax^2+bx+c=0$ kvadrat teńlemesi ushın Viet teoreması:

$$x_1+x_2=-\frac{b}{a}, \quad x_1\cdot x_2=\frac{c}{a}$$

Parametrli kvadrat teńlemeler kóbinese Viet teoremasınan paydalanıp ansat sheshiledi.

1-mısal. x_1 hám x_2 sanları $x^2+3x+m=0$ teńlemesiniń korenleri bolsa, m niń qanday mánisinde teńlemeniń korenleriniń ayırması 6 ǵa teń boladı.

Sheshiw. Meyli $x_1>x_2$ bolsın, onda máseleniń shárti boyınsha $x_1-x_2=6$ boladı. m niń mánisin tabıw ushın berilgen teńlemeniń korenlerin tómendegi teńlemeler sistemasın sheshiw arqalı tabamız:

$$\begin{cases}x_1+x_2=-3\\x_1-x_2=6\end{cases}\Leftrightarrow\begin{cases}x_1+x_2=-3\\x_1=x_2+6\end{cases}\Leftrightarrow\begin{cases}x_2+6+x_2=-3\\x_1=x_2+6\end{cases}\Leftrightarrow$$

$$\Leftrightarrow\begin{cases}2x_2=-9\\x_1=x_2+6\end{cases}\Leftrightarrow\begin{cases}x_2=-\dfrac{9}{2}\\x_1=-\dfrac{9}{2}+6\end{cases}\Leftrightarrow\begin{cases}x_2=-\dfrac{9}{2}\\x_1=\dfrac{3}{2}\end{cases}$$

Viet teoreması boyınsha

$$m=x_1\cdot x_2=\frac{3}{2}\cdot\left(-\frac{9}{2}\right)=-\frac{27}{4}.$$

Juwabı. $m=-\dfrac{27}{4}.$

2-mısal. Eger $x^2-bx-b=0$ teńlemeniń korenleri $x_1^3+x_2^3+x_1^3\cdot x_2^3=27$ shárti menen berilgen bolsa, b nıń mánisin tabıń.

Sheshiw. Berilgen kvadrat teńlemeden Viet teoremasınan paydalanıp tómendegi teńliklerdi jazamız: