

(« »)

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(03.03.02 –) –

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«__»_____201_ .

:

BaSi₂,

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211

(,) . .

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(,) . .

, . - .

(,) . .

(« »)

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«___»_____201_ .

1. :

BaSi₂,

(03.06.16 1215-)

2. : 14 2016 .

3. : ,

,

4. (

): -

100

=600 °C (1) =700 °C (2); -

BaSi₂ ;

BaSi₂

;

1 2;

1 2

;

1 2

·

5. : (, , , ,
, , .): Ba
Si -

6. (-
):

7. : 11.05.2016
:
, . - .

(): 11.05.2016 _____
()

42 ., 20 , 14

VERTEX 80V, -7

PHI-590,

BaSi₂,

1.

100

=600 °C (

1) =700 °C (2);

2.

BaSi₂

3.

BaSi₂

4.

1

2;

5.

1 2

6.

1 2.

		7
1.		9
1.1		9
1.2		10
2.		13
2.1	-	13
2.2		15
2.3		17
2.4		18
2.4.1		19
2.5		20
3.	,	22
3.1	PHI-590	22
3.2		23
3.3	Solver P47	24
3.4	Vertex 80v	25
3.5		-7
4.		28
4.1		28
4.2		31
4.3		33
		39
		40
		42

1.

100

=600 °C (

1) =700 °C (2);

2.

BaSi₂

;

3.

BaSi₂

;

4.

1 2;

5.

1 2 ;

6.

1 2.

1.

;

Si(111).

1)

[3, .428 - 429];

2)

()

3)

[3, .430].

in-situ

1.1

() , (, ,) [4].

1.2

[3].

~ 35° [1].

ленок. ике с
ские квар [1].

f_0 завис d_q тс [3]:

$$F_0 = \frac{N}{d_q}, \tag{1}$$

$$N=1,67 \cdot 10^6$$

~ (~ 5-10)

, асса 1

варце с под ,

у квај Δt и :

Δf :

$$\Delta f = \frac{K f_0^2 \Delta m}{\rho_q N A} = \frac{K N \Delta m}{\rho_q d_q^2 A} \quad (2)$$

ρ_q – (2,65 г/см³), A – пл , K –
инице,

A крис [3].

----- въ некоторе ,

(2) напыленне :

1) Δf и Δt въ , -

----- ;

2) , . -

, ;

3) , -

;

4) , , -

30 °C

5 ± 10^6 °C⁻¹

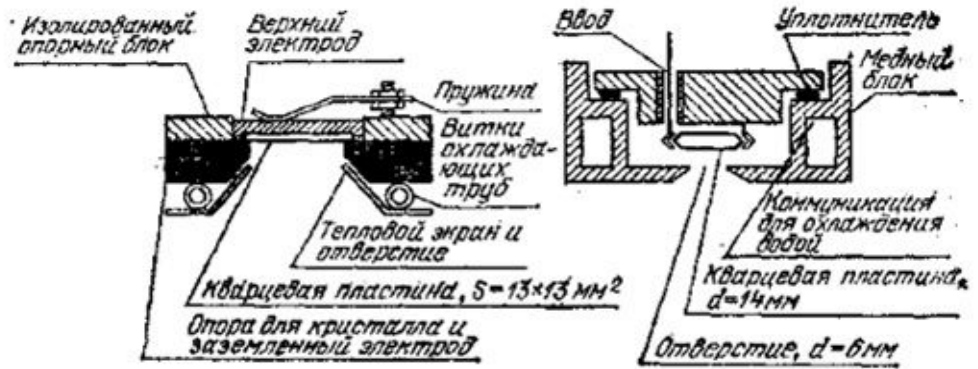
± 30 °C [3].

,

[3].

[1, .145 - 148].

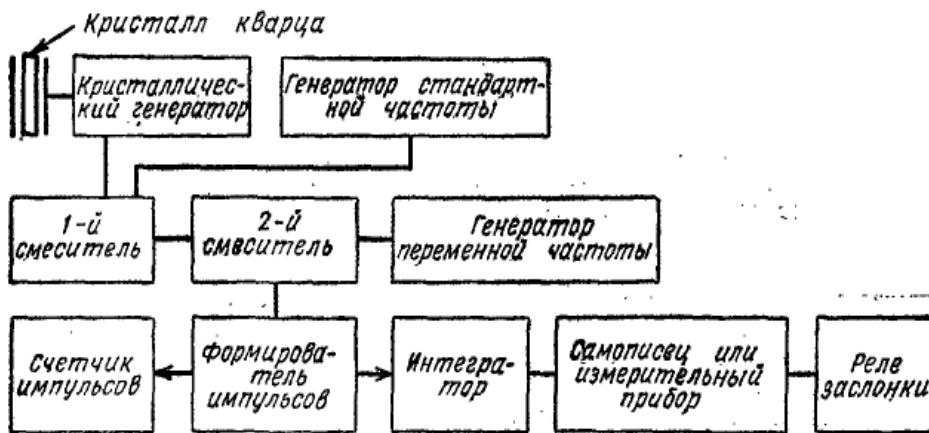
1



1 -

[1, .145]

2.



2-

[1, .149]

2.

2.1

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1920

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0,5-5,0

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$z > 2$,

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[3].

« - »

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(),

,

- Крo [3].

:

$$E_{ABC} = E_A - E_B - E_C(BC: x) + R_x^{внутр} + R_x^{внеш}, \quad (3)$$

F (BC: x) - В С -

R_x - . -

нирог , -

яжение

остов . $R_x^{внутр}$ (

атоме). -----

$R_x^{внеш}$, . , -

--- +- (1), . -

,

- , [3].

3, , -

(-).

. - 1591 , -

1690 ., - -

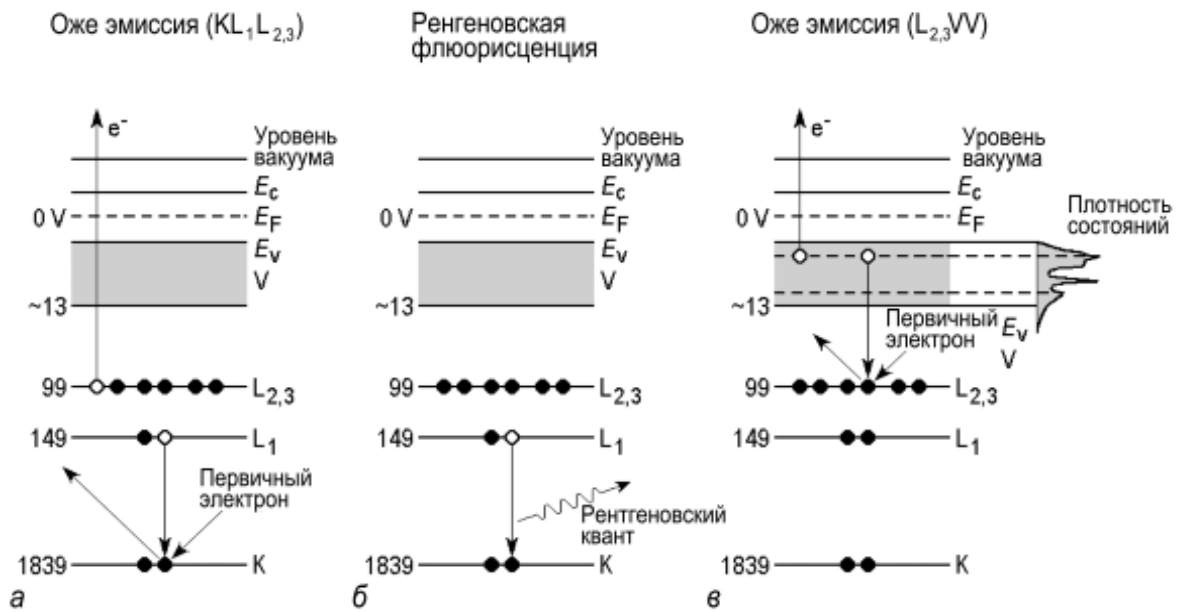
-

H He, -

:

, , [5, .39 -

42].



1591 ,

1690 . -

3 -

[4, с.106]

2.2

АСМ

(4).

[4].

АСМ

(4):

$$U_{LD}(r) = U_0 \left\{ -2 \left(\frac{r_0}{r} \right)^6 + \left(\frac{r_0}{r} \right)^{12} \right\}. \quad (4)$$

, , , -
 .
 , U_0 -
 .
 -
 , -
 .

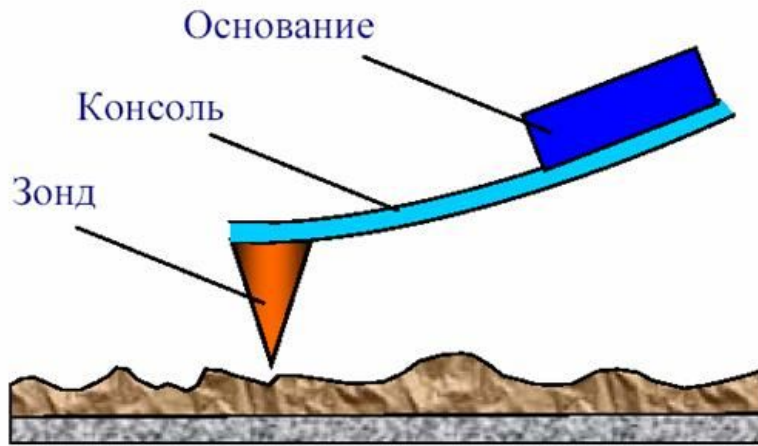
энергия взаимодействия между ними:

$$W_{PS} = \int_{V_p} \int_{V_s} U_{LD}(r - r') n_p(r') n_s(r) dV dV', \quad (5)$$

$n_s(r)$ и $n_p(r')$ - ПЛОТН
 ,
 БИТЬ ВЫЧИСЛЕНА СЛЕД

$$\overline{F_{PS}} = -grad(W_{PS}) \quad (6)$$

[3].



4 –

[4, с.149]

2.3

S_i ,

той
бирае
 N_i в
В, МОЭ

$$N_i = \frac{a \cdot I_i}{S_i} \quad (7)$$

, I_i – сос
), $-S_i$
i-
) [6].

S_i

N

ца, мс. Зн. записать:

$$N = \sum_{i=1}^n \frac{a \cdot I_i}{S_i} \quad (8)$$

(1) (2)

C_x

(женная)

:

$$C_x = \frac{N_x}{N} = \frac{I_x}{S_x} / \sum_{i=1}^n \frac{I_i}{S_i} \quad (9)$$

R.

15%,

[6].

2.4

[7,8].

(d/ 0,05)

[6].

():

$$\frac{\Delta R}{R_{exp}} = \frac{R_a - R_s}{R_s}, \quad (10)$$

$$R_s - R_a = \dots \quad (\dots)$$

2.4.1

[9].

[11]:

$$\frac{\Delta R}{R_s} = 4 \frac{\omega}{c} \cos\theta \frac{\delta\Lambda_y(\omega, T)}{\varepsilon_b(\omega, T) - 1}, \quad (11)$$

$$\delta\Lambda_y(\omega, T) = \int dz \left[\langle \varepsilon_{yy}^{(\alpha)}(z, T) \rangle - \langle \varepsilon_{yy}(z, T) \rangle \right] \quad (12)$$

$$\langle \varepsilon_{\psi\psi}(\zeta, T) \rangle = \langle \varepsilon_{\psi\psi}^{(\alpha)}(\zeta, T) \rangle - \dots \quad \varepsilon(\omega, T);$$

[9].

()

().

(

).

2.5

($\sim 10^{-6} \text{ \AA}^2$)

$\sim 1 \text{ \AA}^2$),

(

)

[3].

:

1)

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,

;

2)

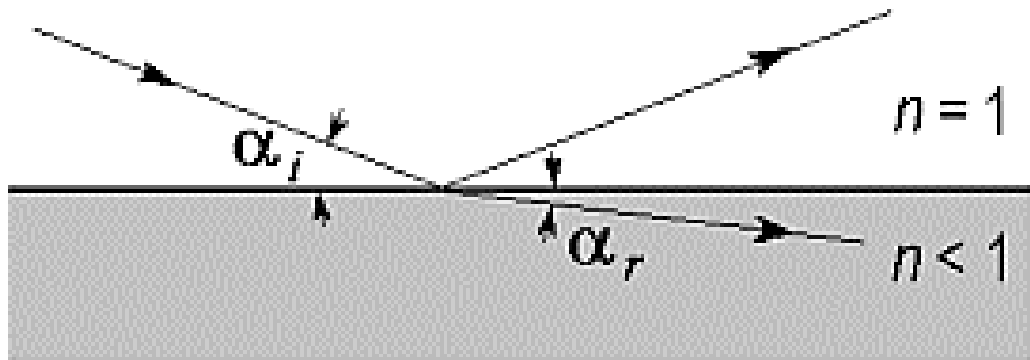
,

«

»

,

[3].



5 –

[3, .88]

лас) закону

:

$$\cos \alpha_i = n \cos \alpha_r, \tag{13}$$

α_i α_r - , , n - ко
 () [3].

[3].

3.

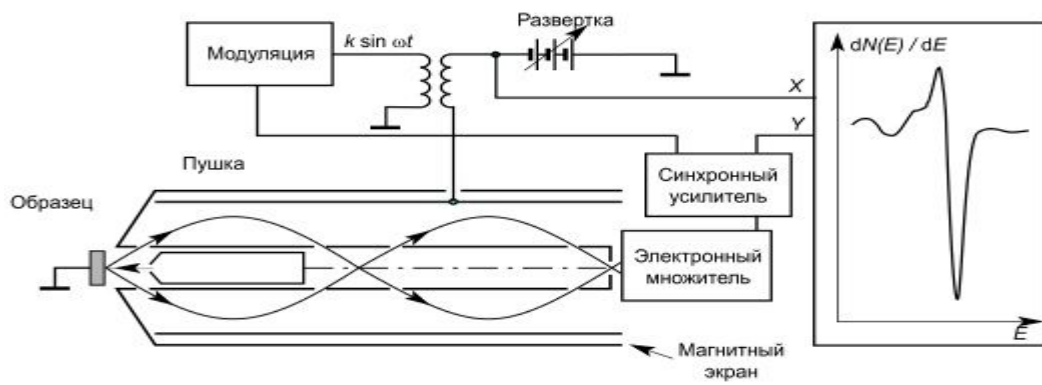
3.1 PHI-590

Ba Si () -
PHI model 590 $\sim 1,33 \cdot 10^{-7}$ (6).

(7).



6 - PHI590



7 -

[3]

- 1) ;
- 2) ,

[13];

- 3) , 2 .

3.2

Sycon Instruments (8).



8 –

USB

Sycon

Instruments

(9)

5 .,



11 – Bruker VERTEX 80v

:1) / : 5 - 680 ⁻¹; 2)
: 380 - 15000 ⁻¹; 3) : 25000 ⁻¹.

VERTEX 80V:

1.

;

2.

3.

3.5

-7

-7

2

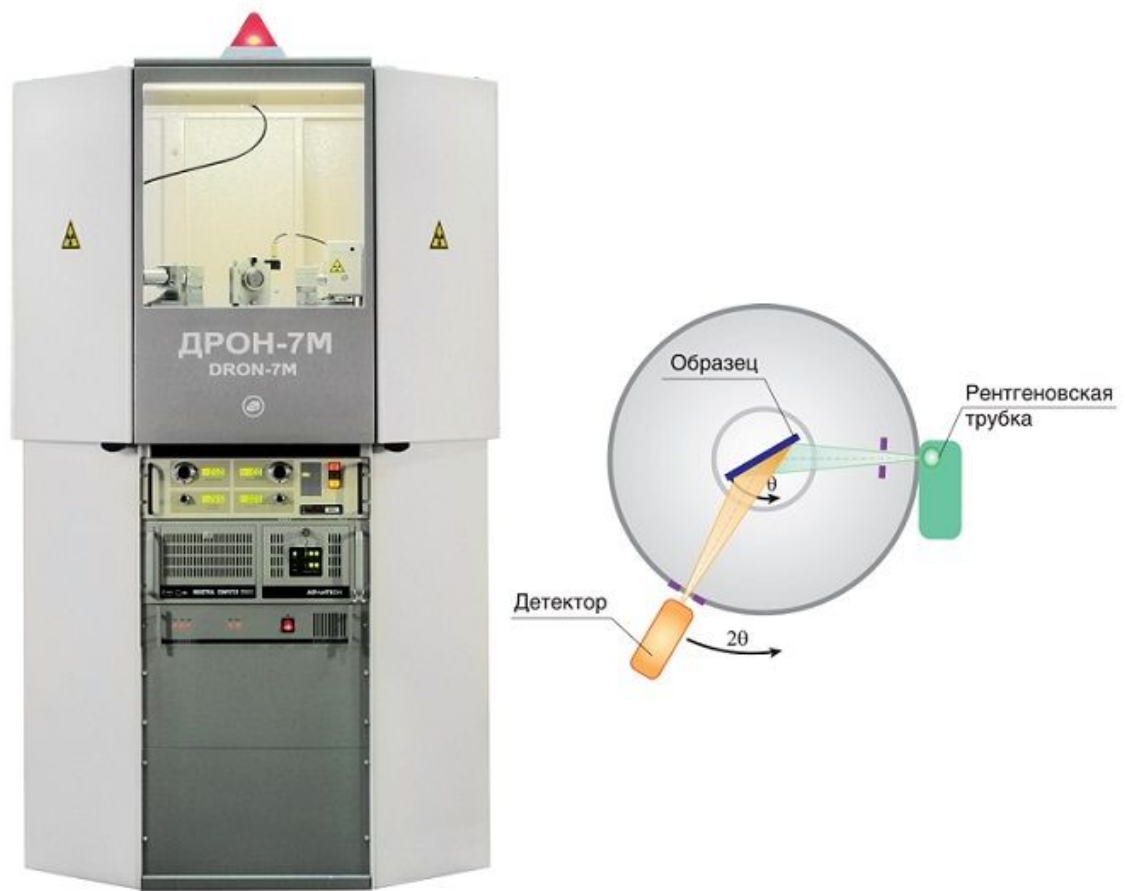
(12)

1)

2

-7 :

- 2) ;
- 3) [14].
- 7 :
- 1) - , - , -
- ;
- 2) , :2 (-100 165); (-180 180);
- 3) , [14].



12 – -7 2 - [14]

4.

4.1

-45 Si(111)

(, p- 45
·)

·

· ,
· Si ()

: T=600 °C T=700 °C 6 ,

- 3-5 (1-2 . -

) T=1250 °C.

Ba (Ta ,

·) 20 . -

1 .

: 1 2.

:

1 T = 600 °C, 2 – T = 700 °C.

- · -

1 - 13:

I – : Si;

II – T_{Si} = 600 °C

Ba 10 : Si + Ba T =600 °C;

III - Ba 20 Si

10 : 2Ba+2Si ;

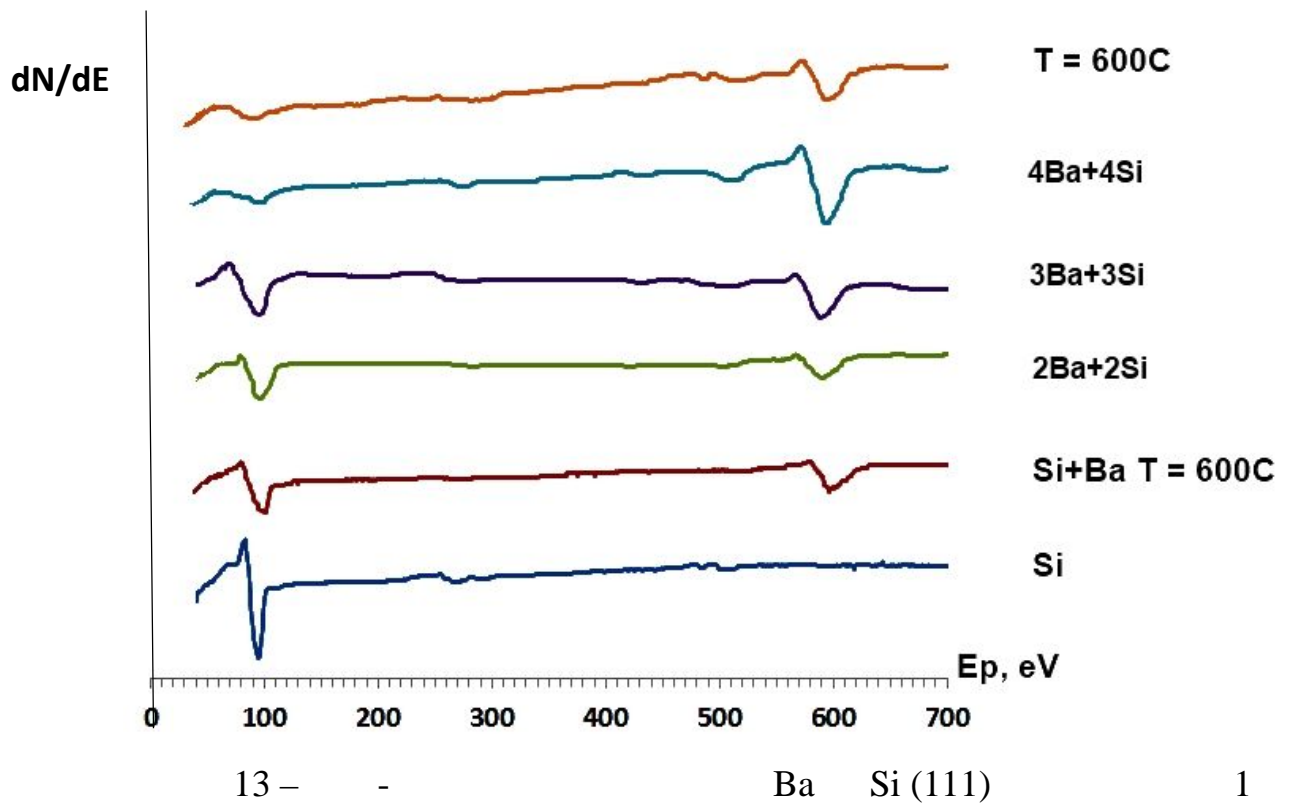
IV - Ba 20 Si

10 : 3Ba+3Si ;

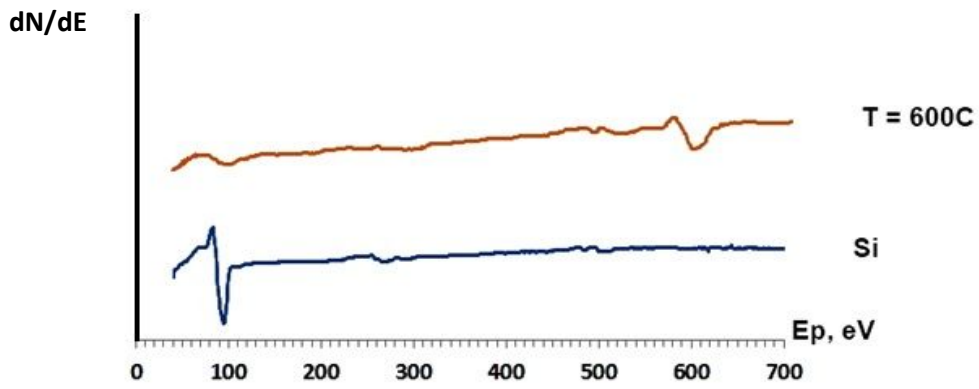
V - Ba 20 Si

10 : 4Ba+4Si ;

VI - T = 600 °C : T = 600 °C.



-
 584 600 . 13 ,
 548 .
 Ba+Si -
 (1 - $T = 600^{\circ}C$) -
 .
 (13)
 (Ba Si) , -
 1.
 14,
 - (), -
 1.



14 -

1 -

S_i

- E_i

	E_i	S_i
Ba	584	0.1(0.12)
Si	92	0.39(0.35)

,

2,

,

VI.

2 -

1

-	II	III	IV	V	VI
C_{Ba}	0.53	0.55	0.56	0.58	0.61
C_{Si}	1.42	1.44	1.46	1.5	1.56

Ba Si, 1:2,2,

,

,

- $BaSi_2$.

4.2

15 (1) 16 (2).

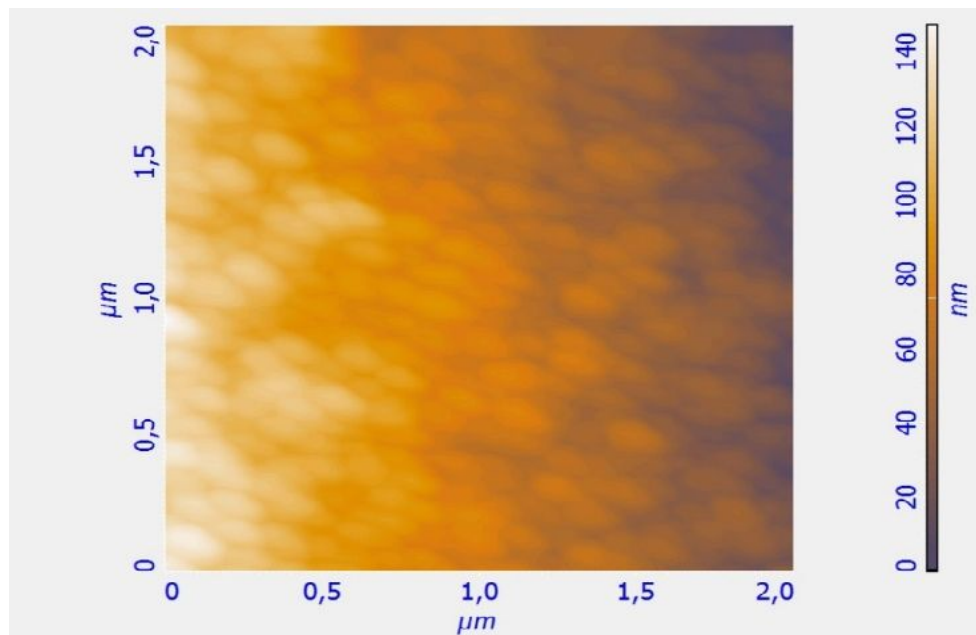
1 (3) 2 (4),

2.

3 –

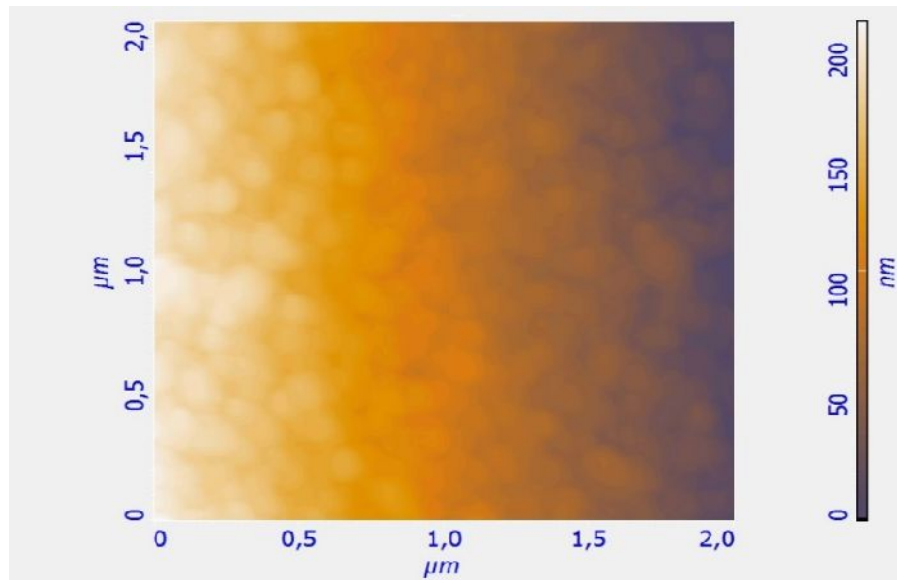
1

R_a , nm	R_{max} , nm	R_q , nm
25.48	197.9	1.997



15 –

1



16 –

2

4 –

2

R_a , nm	R_{max} , nm	R_q , nm
26.13	196.9	1.991

R_a –

13

14.

(,) ,

()

линии, -- численно раи :

$$R_a = \frac{1}{L} \int_0^L |r(x)| dx \quad , \quad (13)$$

искре гучая;

$$R_a = \frac{1}{N} \sum_{n=1}^N |r_n| \quad . \quad (14)$$

R_q -

(15), и по формуле (16):

$$R_q = \sqrt{\frac{1}{L} \int_0^L r(x) dx} \quad (15)$$

$$R_q = \sqrt{\frac{1}{N} \sum_{n=1}^N r_n^2} \quad (16)$$

и по формуле (16) R_q для R_{max} и R_{min} (таблица 1).

Таблица 1

Параметр	Значение
R_a	25,48
R_{a2}	26,13

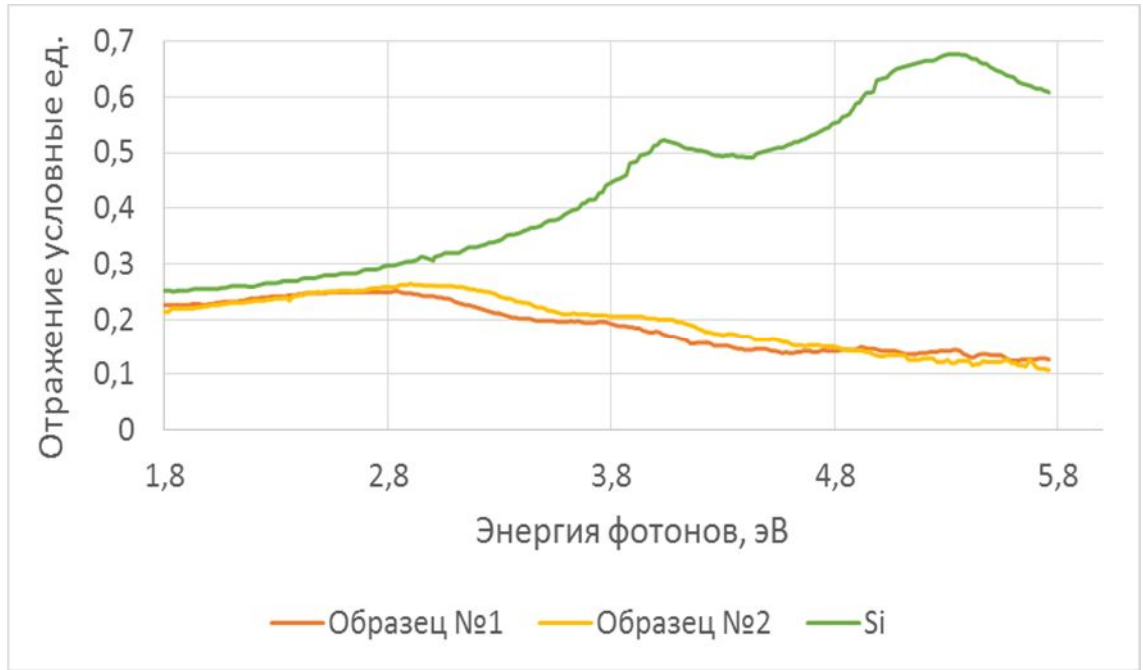
4.3

В таблице 2 приведены результаты измерения коэффициента отражения R_a для образцов $BaSi_2$ и $Si(111)$. Измерения проводились на установке Vertex 80v. Результаты измерений приведены в таблице 2.

Таблица 2

Образец	Число измерений	Значение R_a
$BaSi_2$	1	4,9
$Si(111)$	2	4,9

2 , 4,9 , 4.9
2.



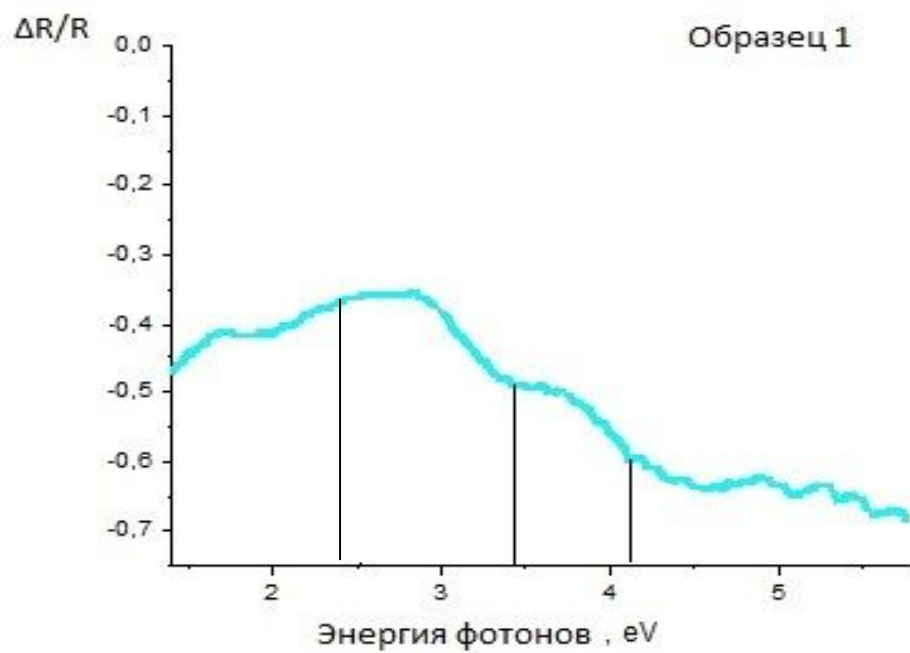
17 –

Si

1 2

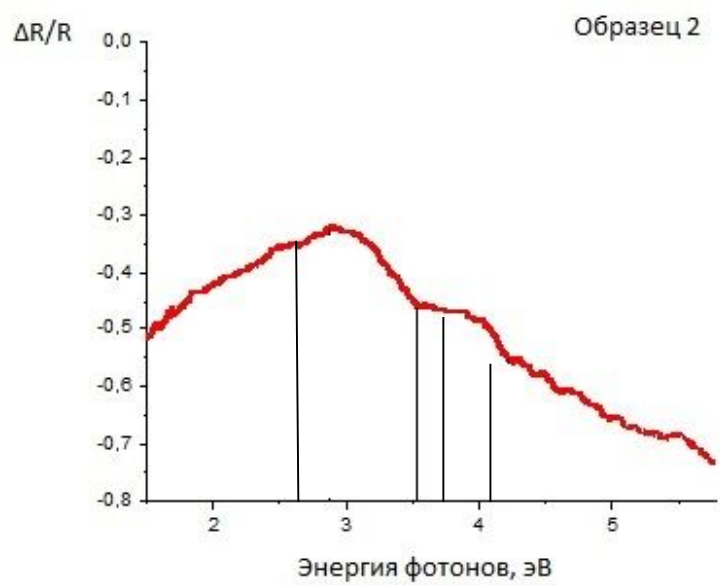
(18 19).

BaSi₂.



18 –

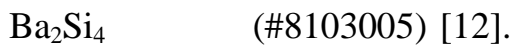
1



19 –

2

3°. $\phi = 1^\circ, 2^\circ, 3^\circ$, $\phi = 2^\circ$, $0,05^\circ$, 2, 15-80
 $^\circ$ (20 a). $T=600^\circ\text{C}$ 20
 1

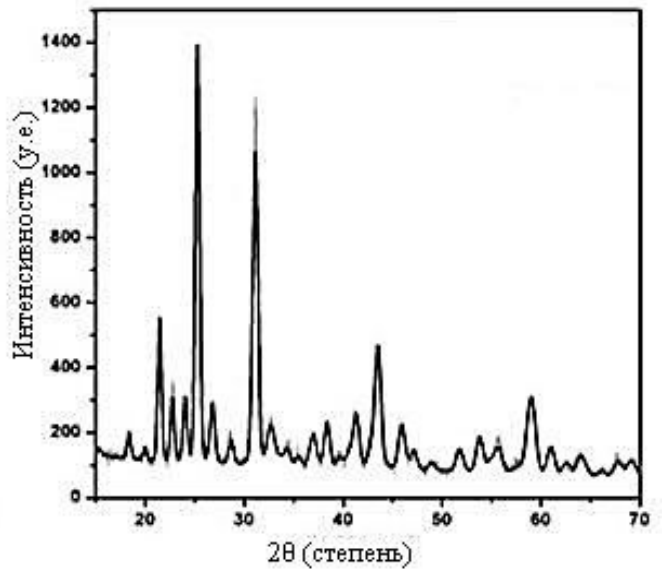
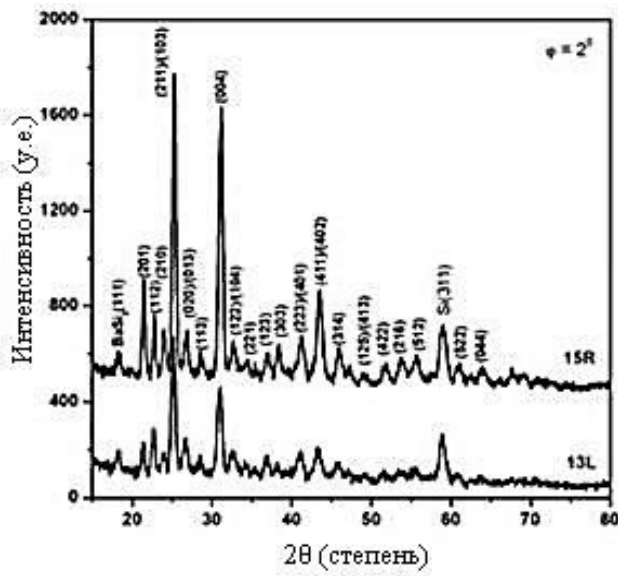


750°C

(2)



1 [12].



) GIXRD

1 2

$\phi = 2^\circ$.)

2

MAUD-
BaSi2 [12]

20 -

, , T=600 °C, -
 ,
 BaSi₂ 2 . 1 2
 (-
). , , 600
 ° - 25,48 ()
 (100-200). -
 750 °C
 26.13 [12].

BaSi₂

100

=600 °C

=700 °C

1.

R_a=25,48

1 (=600 °C)

2 (=700 °C) – R_a=26,13

;

2.

3.

, . . .

, . . .

-

, . . .

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-

:

-

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