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THE SYNTHESES AND INVESTIGATION OF THE SYSTEM $CaTiSiO_5$ - $CaSnSiO_5$

R. A. GRIGORYAN[a]*, L. A. GRIGORYAN[b]

[a] Institute of Structural Macro kinetics and Materials Science RAS

[b] Institute of Problem of Chemical Physics RAS

*rud@ism.ac.ru

It was installed that at ≥700 °C the system $CaTiSiO_5$ - $CaSnSiO_5$ is single-phase [1]. In the persisting message are brought results x-rays, UR studies of the multi-components system $CaTiSiO_5$ - $CaSnSiO_5$ at 1173 K and electro physical characteristics of formed hard solutions. Samples of $CaTi_{1-x}Sn_xSiO_5$ ($0 \le x \le 1,0$; $\Delta x = 0,05$) ware synthesized from oxides of appropriate metals in hydrogen - oxygen flames low temperature plasma [2] and classical ceramic technology.

The X-ray data identification, which was realized with use parameters, provided in work [3], shows, the $CaTiSiO_5$ (x = 0) crystallizes in monoclinic structure. The Ca^{2+} Ions are located inwardly polyhedral emptiness formed by seven oxygen atoms, formed by oxygen atoms of the octahedral TiO_6 and tetrahedral SiO_4.

In structure of titanite crystallize as well as formed hard solutions composition $CaTi_{1-x}Sn_xSiO_5$. Partial or full change Ti^{4+} ion by Sn^{4+} ion in titanite lattice at the temperature 1173K does not bring phase conversions. Entering Sn^{4+} ions occupy the inwardly octahedral emptiness of oxygen packing, ear earlier occupied Ti^{4+} ions. The parameters of an elementary cell are determined. The results were provided in table 1.

Table 1. The parameters of an elementary cells of $CaTi_{1-x}Sn_xSiO_5$ hard solutions

Состав	a	b	c	β, °
$CaTiSiO_5$	7,061±0,004	8,710±0,005	6,568±0,005	113,86 ± 0,04
$CaTi_{0,9}Sn_{0,1}SiO_5$	7,06± 0,01	8,72± 0,01	6,57± 0,01	113,84± 0,05
$CaTi_{0,8}Sn_{0,2}SiO_5$	7,06± 0,01	8,74± 0,01	6,57± 0,01	113,83± 0,05
$CaTi_{0,7}Sn_{0,3}SiO_5$	7,06±0,01	8,76± 0,01	6,57± 0,01	113,83± 0,05
$CaTi_{0,6}Sn_{0,4}SiO_5$	7,07± 0,01	8,78± 0,01	6,57± 0,01	113,72± 0,05
$CaTi_{0,5}Sn_{0,5}SiO_5$	7,07± 0,01	8,80± 0,01	6,57± 0,01	113,82± 0,05
$CaTi_{0,4}Sn_{0,6}SiO_5$	7,07± 0,01	8,82±0,01	6,57± 0,01	113,82± 0,05
$CaTi_{0,3}Sn_{0,7}SiO_5$	7,07±0,01	8,84±0,01	6,57± 0,01	113,80± 0,05
$CaTi_{0,2}Sn_{0,8}SiO_5$	7,08± 0,01	8,85± 0,01	6,58± 0,01	113,78± 0,05
$CaTi_{0,1}Sn_{0,9}SiO_5$	7,08±0,01	8,86± 0,01	6,58± 0,01	113,78± 0,05
$CaSnSiO_5$	7,08 ± 0,01	8,88 ± 0,01	6,58 ± 0.01	113, 77± 0,05

Herewith exists the linear growing a parameter elementary cell, given big, than beside changed titanium ion, radius tin ion. The parameters of an elementary cell vary unsignificantly and are in rectilinear dependence on structure (figure 1).

Using offered author [4, 5] acceptance to got by us parameter brings about conclusion that in synthesized us sample possible to expect that as a result silicon - a deficit in tetrahedral position are found ~ 4 % atoms of titanium. However result of the chemical analysis synthesized us sample [SAO - (28,8 0,3)%, TiO_2 - (40,2 0,3)%, SiO_2 - (30,6 0,4)%, [SAO] : [TiO_2] : [SiO_2] = (0,977 ± 0,007) : (1,000 ± 0,004) : (0,985 ± 0,004)] point to not more than 1,5% silicon deficit.

There are bands of the absorption IR spectrum all synthesized composition with maximum at frequency 465 - 470 cm^{-1} and 495 - 500 cm^{-1}, referred fluctuations of SiO_4 tetrahedron. The maximum in the field of 555 - 565 cm^{-1} were referred to oscillatory absorption of SnO_6 and TiO_6 octahedrons. On measure of the increase the contents tin on UR spectrum appears clearly denominated maximum under 565 cm^{-1}, referred oscillatory absorption SпO$_6$ octahedron, which already under x = 0,4 masks weakly denominated maximum (565 cm^{-1}), belong to TiO_6 octahedron. they was determined factors of the refraction hard solutions

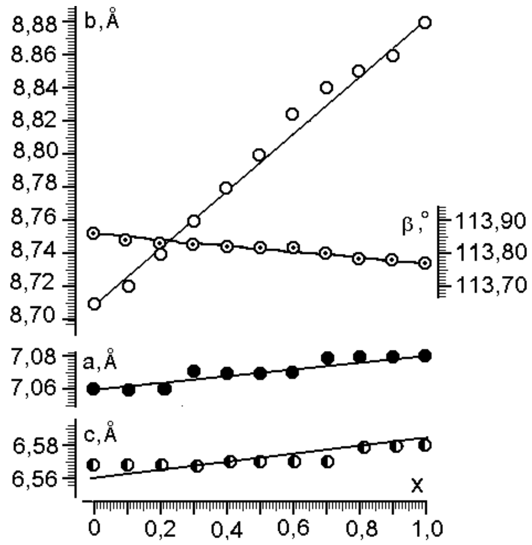

Figure 1. The dependency of parameters of elementary cells of $CaTi_{1-x}Sn_xSiO_5$ hard solutions

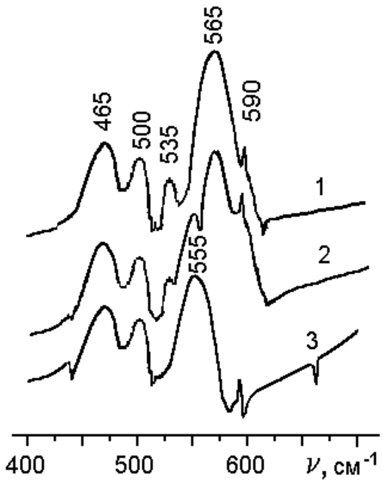

Figure 2. Infra-red spectra of (1) $CaSnSiO_5$, (2) $CaTi_{0,7}Sn_{0,3}SiO_5$ and (3) $CaTiSiO_5$

Parameters of refractions of the hard solutions were installed. The results were provided in table 2.

Table 2. Parameters of refractions of the $CaTi_{1-x}Sn_xSiO_5$ hard solutions

Состав	n_g	n_p
$CaTiSiO_5$	~1,876	
$CaTi_{0,8}Sn_{0,2}SiO_5$	1,862	~2,37
$CaTi_{0,6}Sn_{0,4}SiO_5$	1,855	~2,37
$CaTi_{0,4}Sn_{0,6}SiO_5$	1,862	~2,37
$CaTi_{0,2}Sn_{0,8}SiO_5$	≤1,890	1,869
$CaSnSiO_5$	2,08	≤2,68

Table 2. Specific electro-conductivity (σ), dielectric permeability (ε), width of the forbidden zone (energy of activation DE), molar polarization (P) and molecular polarizability (α) of hard solutions $CaTi_{1-x}Sn_xSiO_5$

	σ ($ом^{-1}.см^{-1}$)	ε	ΔE (ev)	P	$α.10^{23}$
$CaTiSiO_5$	$3,802.10^{-12}$	39	0,973	51,62	2,0472
$CaTi_{0,9}Sn_{0,1}SiO_5$	$2,884.\ 10^{-12}$	43	0,970	52,09	2,0659
$CaTi_{0,8}8Sn_{0,2}SiO_5$	$2,239.10^{-12}$	43	0,983	52,27	2,073
$CaTi_{0,7}Sn_{0,3}SiO_5$	$1,905.10^{-12}$	48	1,005	52,65	2,088
$CaTi_{0,6}Sn_{0,4}SiO_5$	$1,489.10^{-12}$	53	1,028	53,30	2,114
$CaTi_{0,5}Sn_{0,5}SiO_5$	$1,318.10^{-12}$	56	1,055	53,53	2,123
$CaTi_{0,4}Sn_{0,6}6SiO_5$	$1,000.10^{-12}$	62	1,073	54,00	2,142
$CaTi_{0,3}Sn_{0,7}7SiO_5$	$7,244.10^{-13}$	65	1,097	54,19	2,149
$CaTi_{0,2}Sn_{0,8}SiO_5$	$4,721.10^{-13}$	70	1,118	54,30	2,154
$CaTi_{0,1}Sn_{0,9}SiO_5$	$2,884.10^{-13}$	75	1,144	54,63	2,1667
$CaSnSiO_5$	$2,366.10^{-13}$	79	1,165	54,91	2,178

All of synthesized solid solutions are dielectrics with semiconductor nature of conduction. Change ion Ti^{4+} on Sn^{4+} brings the small reduction the specific conductivity.

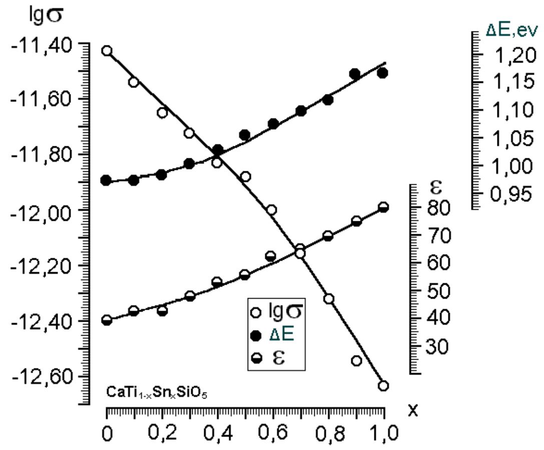

Figure 2. The specific conductivity, width of the forbidden zone (energy of activation) and dielectric permeability of the $CaTi_{1-x}Sn_xSiO_5$ hard solutions.

Under full change ion Ti^{4+} on ions Sn^{4+} conduction sample decreases on one order. Herewith exists small increase the width of the forbidden zone, dialectical permeability and molecular polarization.

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