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АРМЕНИЯ

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SYNTHESIS AND INVESTIGATION OF $YFeTiO_5$ - $YFeSnO_5$ MULTICOMPONENT SYSTEM

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It was firstly investigated YFeTiO5 - $YFeSnO_5$ multi component system by x -rays methods.

Samples of $YFeTi_{1-x}Sn_xO_5$ ($0 \le x \le 1,0$, $\Delta x = 0,1$) ware synthesized from oxides of appropriate metals in hydrogen - oxygen flames low temperature plasma [1] and classical ceramic technology. All synthesized samples were roasted at T = 1170K during four hours. The X-ray diffractions of samples with equal composition synthesized by different ways are identical. Comparison powder difractograms of samples have shown structural uniformity of system $YFeTiO_5$ - $YFeSnO_5$, representing continuous number of firm solutions with which reach on all concentration intervals. The formed firm solutions crystallize in rhombic system of pseudo-brookite structure. The parameters of an elementary cell are determined. The results were provided in table 1.

Table 1. The parameters of an elementary cells of $YFeTi_{1-x}Sn_xO_5$ hard solutions

Compound	a, Å	b, Å	c, Å	d, g/sm^3	
	± 0,005			x-ray	Picn..
$YFeTiO_5$	10,746	9,922	3,849	4,412	4,35
$YFeTi_{0,9}Sn_{0,1}O_5$	10,746	9,922	3,852	4,454	4,41
$YFeTi_{0,9}Sn_{0,1}O_5$	10,746	9,922	3,852	4,454	4,41
$YFeTi_{0,7}Sn_{0,3}O_5$	10,744	9,923	3,858	4,660	4,58
$YFeTi_{0,6}Sn_{0,4}O_5$	10,744	9,923	3,863	4,771	4,72
$YFeTi_{0,5}Sn_{0,5}O_5$	10,743	9,923	3,865	4,905	4,87
$YFeTi_{0,4}Sn_{0,6}O_5$	10,744	9,923	3,866	5,004	4,91
$YFeTi_{0,3}Sn_{0,7}O_5$	10,743	9,923	3,868	5,113	5,02
$YFeTi_{0,2}Sn_{0,8}O_5$	10,742	9,924	3,871	5,189	5,13
$YFeTi_{0,1}Sn_{0,9}O_5$	10,742	9,925	3,874	5,333	5,30
$YFeSnO_5$	10,742	9,925	3,878	5,516	5,42

The replacement of titanium atoms on atoms of tin in connection $YFeTiO_5$ does not result in essential changes of a crystal lattice. The parameters of an elementary cell vary unsignificantly and are in rectilinear dependence on structure. Density of samples most considerably vary, which meanings too have rectilinear dependence on composition (figure 1). Some increase of the sizes of an elementary cell at transition from $YFeTiO_5$ up to $YFeSnO_5$, is conditioned different ionic radius tin and titanium (effective ionic radius of Sn^{4+} is 0,690 Å and effective ionic radius of Ti^{4+} is 0,605 Å [2]).

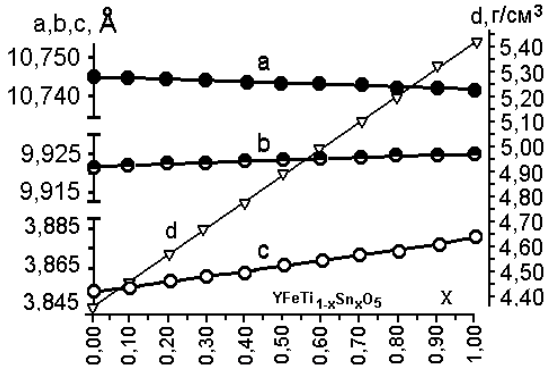

Figure 1. The dependency of parameters of elementary cells and density of hard solutions $YFeTi_{1-x}Sn_xO_5$ from tin contents.

The received results give the basis to assume similar cation distribution in firm solutions of structures YFeTi O_5-$YFeSnO_5$ with those in pseudo-brookite (Fe_2TiO_5) structure [3]. The atoms of tin, replacing atoms titanium in octahedral interstice, occupy the same positions. Hence, in the formed firm solutions of structures $YFeTiO_5$-$YFeSnO_5$ atoms titanium and tin have identical octahedral coordination, while atoms yttrium, as well as the not replaced atoms of iron have characteristic for pseudo-brookite "unusual coordination" [3], which can be considered or as deformed octahedron, or as deformed tetrahedron.

Table 2.The conductivity (σ), dielectric permeability (ε) and widths of the forbidden zone (E) of hard solutions $YFeTi_{1-x}Sn_xO_5$

	σ, $ом^{-1}.см^{-1}$	ε	ΔE	P	α
$YFeTiO_5$	$3,969.10^{-8}$	26	0,875	55,177	2,188
$YFeTi_{0,9}Sn_{0,1}O_5$	$3,963.10^{-8}$	27	0,885	58,614	2,325
$YFeTi_{0,8}Sn_{0,2}O_5$	$3,062.10^{-8}$	27	0,892	60,001	2,380
$YFeTi_{0,7}Sn_{0,3}O_5$	$2,100.10^{-8}$	29	0,915	58,559	2,322
$YFeTi_{0,6}Sn_{0,4}O_5$	$1,503.10^{-8}$	30	0,940	58,465	2,319
$YFeTi_{0,5}Sn_{0,5}O_5$	$7,261.10^{-9}$	31	0,975	58,091	2,304
$YFeTi_{0,4}Sn_{0,6}O_5$	$3,622.10^{-9}$	32	0,985	58,251	2,310
$YFeTi_{0,3}Sn_{0,7}O_5$	$1,791.10^{-9}$	33	1,005	58,169	2,307
$YFeTi_{0,2}Sn_{0,8}O_5$	$9,204.10^{-9}$	35	1,040	58,448	2,318
$YFeTi_{0,1}Sn_{0,9}O_5$	$4,887.10^{-10}$	35	1,045	58,093	3,304
$YFeSnO_5$	$2,23.10^{-10}$	35	1,074	57,215	2,269

The research of physical properties of the synthesized firm solutions (table 2.) shows, that all of them are dielectric, with semi-conductor character electro conductivity replacement of atoms титана by atoms tin results to natural (practically rectilinear) change of these parameters. The complete replacement Ti → Sn results in decrease specific electro conductivity of samples up to two orders, as result of increase of energy of activation (width of the forbidden zone).

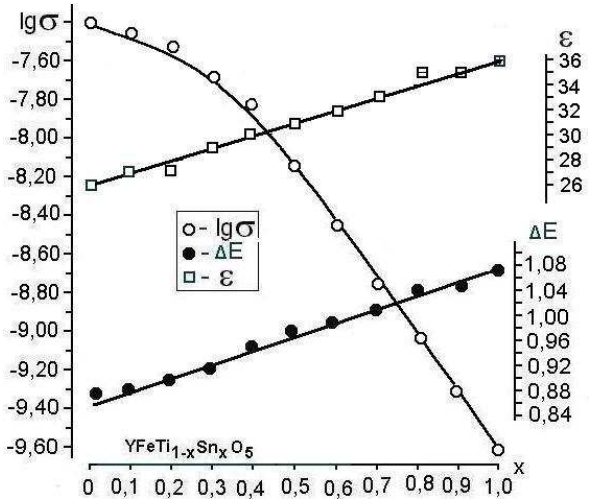

Figure 2. Dependency of conductivity (σ), dielectric permeability (ε and widths of the forbidden zone (E) of hard solutions $YFeTi_{1-x}Sn_xO_5$ from tin contents.

The dependence of the logarithm specific electro conductivity from structure rejects from straightforwardness a little. The replacement up to 40 % titanium results less than three-multiple reduction specific electro conductivity (from 3,969.10-8 up to 1,503.10-8 $ом^{-1}.см^{-1}$). The further introduction of tin results in its faster decrease. In this area of concentration the diagram the dependence of the logarithm specific electro conductivity from structure has rectilinear character (figure 2).

References

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