INTERACTION OF THE COMPONENTS IN THE Ni-Zn-Bi TERNARY SYSTEM AT 570 K

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INTRODUCTION

An investigation of the interaction of the components in the Ni-Zn-Bi system was not carried out earlier. There is also no literature data on crystal structure investigations of ternary compounds of this system. An investigation of the Ni-Zn, Ni-Bi, Zn-Bi binary systems was not undertaken because they were studied well and are described in the literature [1-10]. Crystallographic data of binary compounds that form in the Ni-Zn, Ni-Bi, Zn-Bi systems are shown in Table 1.
In this paper we report the results of an investigation of the isothermal section of the Ni-Zn-Bi system at 570 K and crystal structure data of the occurring intermetallic compounds.

EXPERIMENTAL DETAILS

The experimental investigation of the Ni-Zn-Bi phase equilibria was carried out by means of X-ray powder analysis, metallographic analysis, SEM/EDX (scanning electron microscope with energy dispersive X-ray microanalysis). The 47 samples with different compositions were prepared by arc and levitation melting in an argon atmosphere and then annealed at 570 K for 400 h. Purity of the elements was: Ni – 99.99 wt.%, Zn – 99.9 wt.%, and Bi – 99.98 wt.%. X-ray powder patterns were obtained using DRON-2.0 powder diffractometer with FeK_α radiation and SIEMENS D5000 diffractometer with CoK_α radiation. Indexing of the diffractograms was made using program TREOR-90. The unit cell parameters were refined using program LATCON. The crystal structure was refined from powder patterns with program DBW-3.25 [11].

RESULTS AND DISCUSSION

The isothermal section of the Ni-Zn-Bi phase diagram at 570 K is shown in Fig. 1. One ternary compounds was found at this temperature. NiZnBi ternary compound crystallized in structure type MgAgAs (space group F 4 3m, Pearson symbol cF12, a=0.58935(9) nm). The crystal structure of new ternary compound NiZnBi was refined by Rietveld Profile analysis. The atomic parameters for the NiZnBi structure were refined to R=0.075 and are listed in Table 2. Observed and calculated profiles of NiZnBi and the

differences between them are shown in Fig. 2. Unit cell and coordination polyhedra for the atoms in the NiZnBi structure are shown in Fig. 3.

Table 1. Crystallographic parameters for the binary compounds of the Ni-Zn, Ni-Bi and Zn-Sb systems

Compound	Structure type	Space group	Lattice parameters, nm			References
			a	b	c	
NiZn (β)	CsCl	$Pm\bar{3}m$	0.29083			3
NiZn (β_1)	AuCu	P4/mmm	0.3895		0.3214	3
NiZn	In	I4/mmm	0.27560		0.31927	4
NiZn	ZnS	$F\bar{4}3m$	0.5411			5
$NiZn_3$ (γ)	$NiZn_3$	Abm2	3.3326	1.2499	0.8869	6
Ni_3Zn_{14} (γ)	Cu_5Zn_8	$I\bar{4}3m$	0.89206			7
Ni_3Zn_{17} (γ)	Cu_5Zn_8	$I\bar{4}3m$	0.89186			5
$NiZn_8$ (δ)	$NiZn_8$	C2/m	1.337	0.747 β=113.3°	0.765	8
NiBi	NiAs	$P6_3/mmc$	0.407		0.535	9
$NiBi_3$	$CaLiSi_2$	Pnma	0.8884	0.4101	1.1485	10

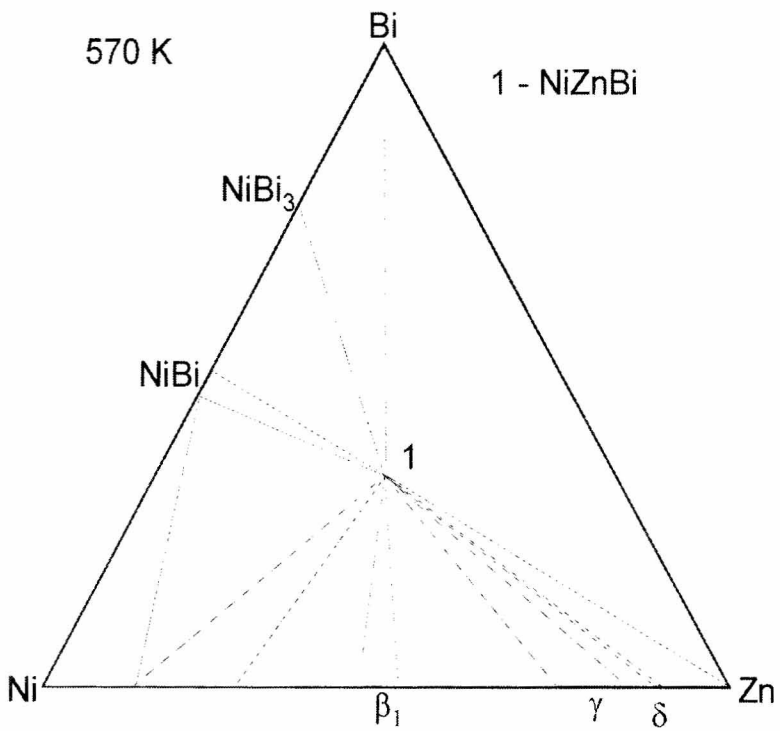

Figure 1. Isothermal section of the Ni-Zn-Bi phase diagram at 570 K

Table 2. Atomic parameters of the NiZnBi ternary compound

Atom	Site	x/a	y/b	z/c	B_i
Ni	4(a)	0	0	0	1.4(1)
Zn	4(c)	1/4	1/4	1/4	1.5(2)
Bi	4(d)	3/4	3/4	3/4	1.1(2)

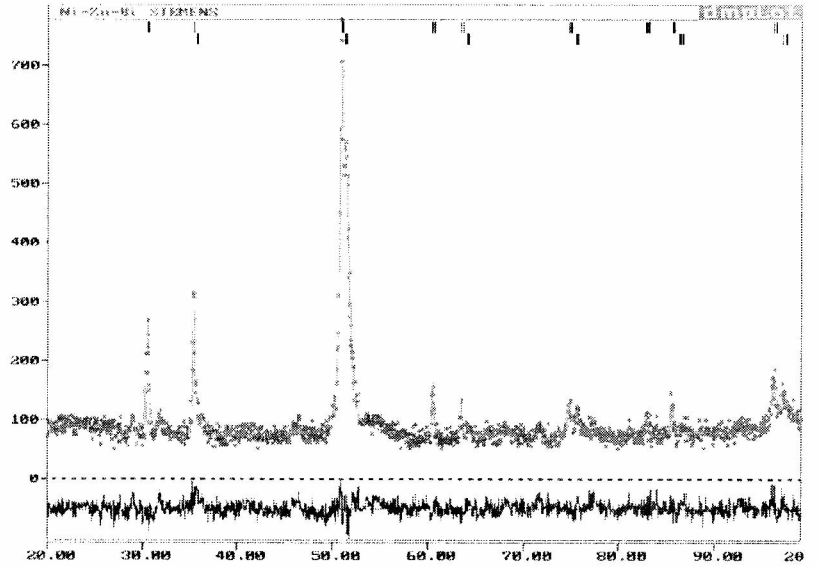

Figure 2. Observed and calculated profiles of NiZnBi and the differences between them.

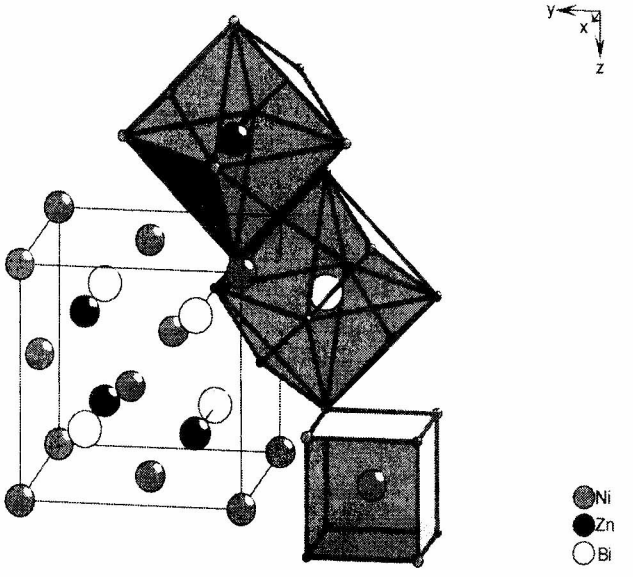

Figure 3. Unit cell and coordination polyhedra for the atomsin the NiZnBi structure.

EDX-analysis of sample $Ni_{60}Zn_{10}Bi_{30}$ was carried out to check the existing of ternary compound with Ni_3ZnSb_2 structure type [12]. It turned out, that sample contents of two phases – NiBi and (Ni). Secondary electron image of sample is shown in Fig. 4.
Solubility of third component in binary compounds was not observed.

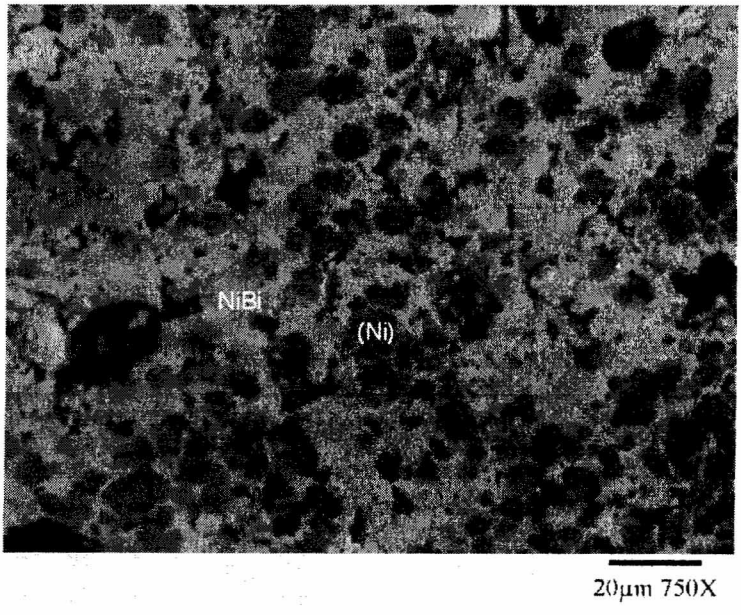

Figure 4. Secondary electron image of sample $Ni_{60}Zn_{10}Bi_{30}$.

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