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Interaction of the Components in the Sr-Y-Cu and Sr-Cu-Bi Systems

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Schematic phase diagrams of the ternary systems Sr-Y-Cu and Sr-Cu-Bi were constructed based on the investigation of as-cast alloys. In the former, seven three-phase fields but no ternary compounds were observed. An extended solid solution based on the binary compound $SrCu_5$ with $CaCu_5$-type structure was found. In the latter, the formation of the compound SrCuBi was confirmed and the equilibria between this compound and the compounds in the binary systems were established. Oxidation of a sample of composition $SrCu_{1.7}$ in air at 800°C led to the formation of more than 80 wt. % of the spin-ladder compound $Sr_{14}Cu_{24}O_{41}$.

Key words: strontium, yttrium, copper, bismuth, phase diagram, crystal structure.

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Introduction

Alloys that contain rare-earth elements (or Y), alkaline-earth metals and copper can be used as precursors for high-T_c superconductors and related cuprates, for instance spin-ladder compounds. The phase diagram of the ternary system Sr-Y-Cu has not been systematically investigated but the phase diagrams have been proposed for the boundary binary systems. According to [1] there exist no compounds in the binary system Sr-Y (diagram of monotectic character), whereas the systems Sr-Cu and Y-Cu contain two and five compounds, respectively. The compound SrCu crystallizes with BaCu structure type, space group $P6_3/mmc$ [2], and the compound $SrCu_5$ with $CaCu_5$ structure type, space group $P6/mmm$ [3]. Crystallographic characteristics of the compounds YCu (CsCl, $Pm\text{-}3m$) and YCu_2 (KHg_2, $Imma$) are reported in [4] and [5], respectively. Some authors report the existence of a high-temperature modification of the compound YCu_2 above 860°C [1,6] (structure not known). The compound Y_2Cu_7 with unknown crystal structure was absent in [7] but is present in the phase diagrams [1,6,8]. The data on YCu_4 with unknown crystal structure and on YCu_7 with hexagonal structure are contradictory. According to [7], the phase YCu_4 has a narrow homogeneity range, whereas in [1,6,8] it is shown as a compound with fixed composition. The same is true for the phase YCu_7 (composition from [1]; $TbCu_7$ structure type, $P6/mmm$ [9]). In [6,8] it has composition YCu_6 with a narrow homogeneity range. The existence of the five Y-Cu compounds (1:1, 1:2, 2:7, 1:4, 1:6) was confirmed by Fries et al. [10].

The phase diagram of the ternary system Sr-Cu-Bi has so far not been constructed, but crystal data for the compound SrCuBi have been published. It crystallizes with a hexagonal structure (ZrBeSi, $P6_3/mmc$) [11]. According to [1], there are no compounds in the binary system Cu-Bi (diagram of eutectic character). The

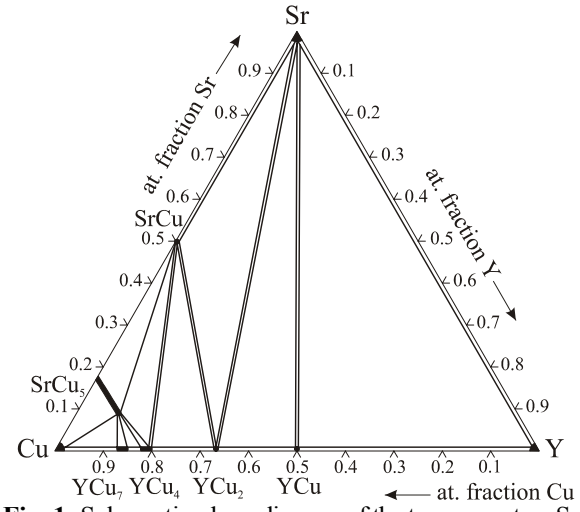

Fig. 1. Schematic phase diagram of the ternary system Sr-Y-Cu.

interaction between Sr and Bi has been investigated repeatedly, but the phase diagram cannot be considered as finally established. The phase diagram shown in [1] contains four compounds: $SrBi_3$ ($AuCu_3$, $Pm\text{-}3m$ [12]), SrBi (unknown structure), Sr_3Bi_2 (unknown structure) and Sr_2Bi (La_2Sb, $I4/mmm$, a = 0.501(2) nm, c = 1.768(3) nm [13]), although in the literature crystal data have been reported also for the compounds Sr_5Bi_3 (α-modification: Mn_5Si_3, $P6_3/mcm$, a = 0.95037(5) nm, c = 0.74095(8) nm [14]; β-modification: Yb_5Sb_3, $Pnma$, a = 1.3370 nm, b =

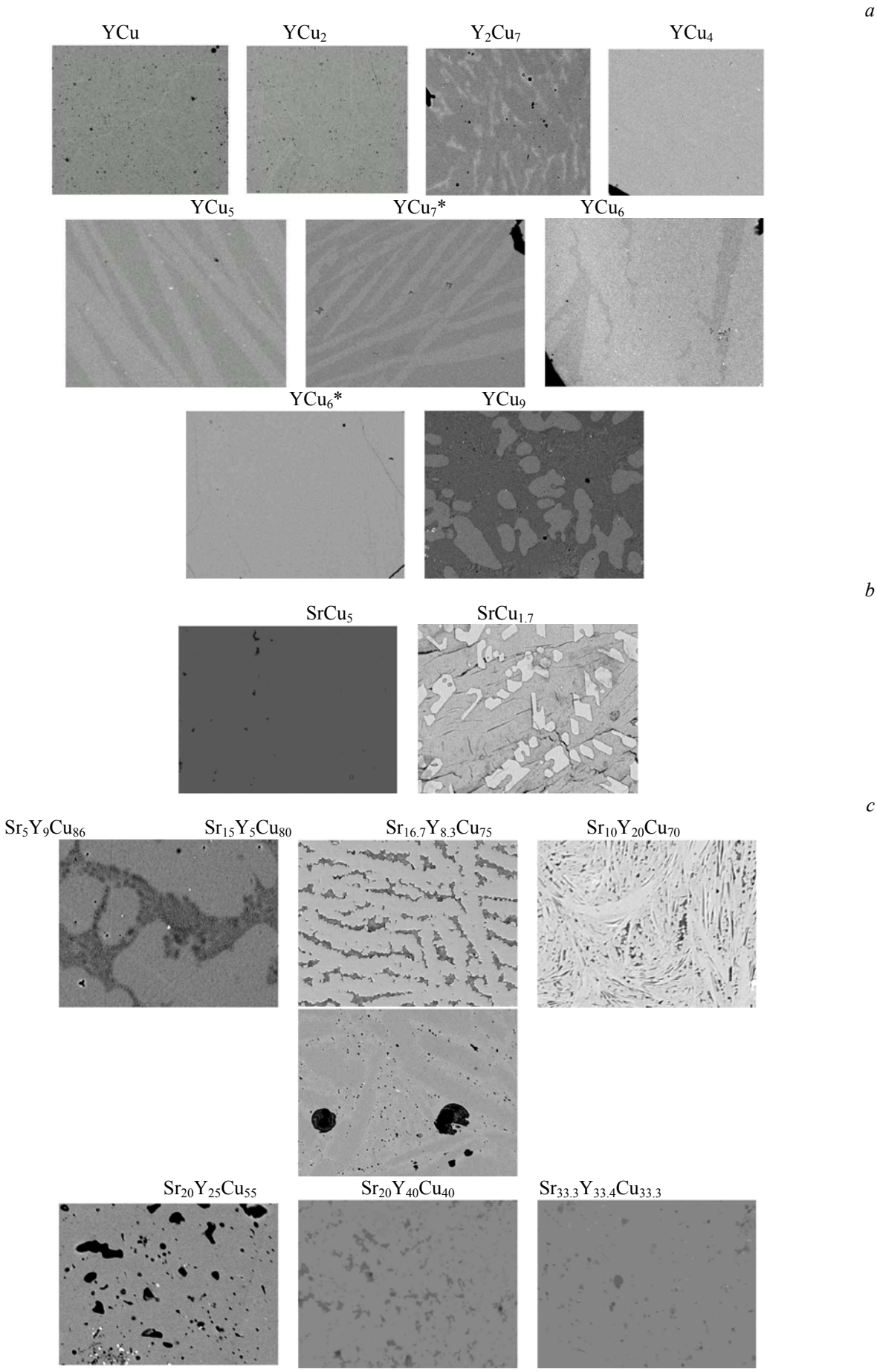

Fig. 2. Surfaces of the samples obtained from scanning electron microscopy.

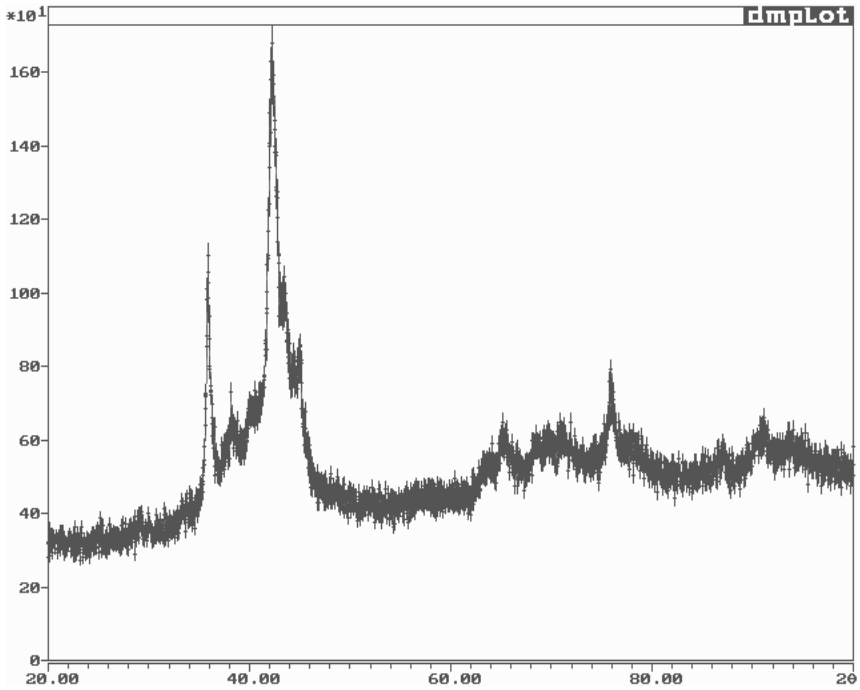

Fig. 3. X-ray diffraction pattern for the sample YCu_4 (Cu Kα radiation).

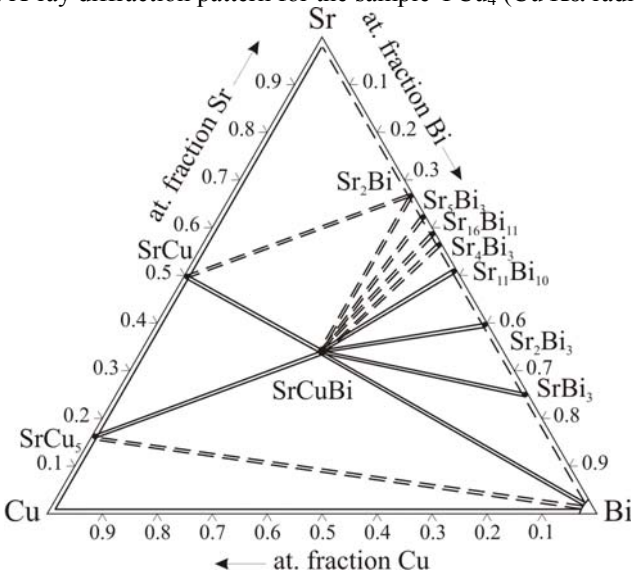

Fig. 4. Schematic phase diagram of the ternary system Sr-Cu-Bi. The dashed lines represent possible phase equilibria.

1.0233 nm, c = 0.8890 nm [15]), $Sr_{16}Bi_{11}$ ($Ca_{16}Bi_{11}$, P-42_1m, a = 1.3152(1) nm, c = 1.1934(2) nm [16]), $Sr_{11}Bi_{10}$ ($Ho_{11}Ge_{10}$, $I4/mmm$ [17]), Sr_4Bi_3 (anti-Th_3P_4, I-43d, a = 1.0101(1) nm [18]), Sr_2Bi_3 (Sr_2Bi_3, $Pnna$, a = 1.2801(3) nm, c = 1.8451(6) nm [17]). The phases on the diagram with unknown structures, SrBi and Sr_3Bi_2, should be probably identified as the compounds $Sr_{11}Bi_{10}$ and $Sr_{16}Bi_{11}$, respectively.

In this work the interaction of the components in the ternary systems Sr-Y-Cu and Sr-Cu-Bi was investigated on as-cast alloys.

I. Experimental

Pure metals were used as starting elements (Sr: 99.9%, Y: 99.9%, Cu: 99.999%, Bi: 99.9%). For the investigation of the phase diagram of the ternary system Sr-Y-Cu twelve two-component and seven three-component alloys were prepared by melting constituent metals in arc-welded tantalum crucibles under an argon flow in an induction furnace. In addition two alloys with initial compositions YCu_6 and YCu_7 were prepared by arc-melting. For the investigation of the ternary system Sr-Cu-Bi five three-component alloys were prepared by induction melting.

All operations for the preparation of Sr-containing alloys were carried out in a glovebox with Ar atmosphere. X-ray phase and structural analyses were made on data collected on automatic powder diffractometers Huber 645 (transmission mode; Guinier geometry; data collected under vacuum) and Philips X'PertMPD (Bragg-Brentano geometry). The diffraction patterns were recorded with Cu $K\alpha_1$ (quartz monochromator) or Cu Kα radiation in the 0-50°ϑ or 10-

100°2ϑ angular range, with a step of 0.01°ϑ or 0.03°2ϑ and a counting time per step of 20s or 3s for Huber and Philips diffractometers, respectively. The structures were refined with the DBWS program [19]. The samples were also characterized by light optical microscopy (DM4000M) and scanning electron microscopy (Stereoscan 200 and EVO40). Quantitative analyses were performed with an acceleration voltage of 20 kV for 50s or 80s, using a cobalt standard for calibration.

All analyses were carried out on as-cast alloys.

Some of the alloys were oxidized in air at 500°C, 600°C or 800°C, and products were characterized by X-ray powder diffraction (DRON-2.0 diffractometer, Fe Kα radiation).

II. Results and discussion

The schematic phase diagram of the ternary system Sr-Y-Cu resulting from this investigation is shown in Fig. 1. No ternary compounds were observed. The existence of the binary compounds YCu, YCu_2, YCu_4, and YCu_7 in the binary system Y-Cu, and SrCu and $SrCu_5$ in the binary system Sr-Cu, was confirmed (see table 1, Figs. 2*a* and 2*b*). The alloy of composition YCu_4 was single-phase based on the microstructural analysis, and the diffuse X-ray powder pattern (Fig. 3) is closely similar to that reported by Fries et al. [10]. These authors ascribed the unusual features of the diffractogram to the occurrence of random, non-periodic defects in the parent $CaCu_5$-like structure. The compound Y_2Cu_7 reported in [1,6,8] and formed by peritectic reaction at 925°C was not observed in as-cast alloys. The alloy with corresponding nominal composition was a two-phase sample and contained the phases YCu_2 and YCu_4. According to our data the compound YCu_7 has a homogeneity region that stretches from ~85 to 87 at.% Cu (a = 0.4974(2)-0.4939(1) nm, c = 0.4119(2)-0.4156(1) nm). The homogeneity region of the YCu_4 compound extends from ~80 to 83 at.% Cu.

An extended solid solution, reaching 10 at.% Y (half of the Sr atoms are replaced by Y), was found based on the binary compound $SrCu_5$ by scanning electron microscopy (table 2). X-ray diffraction showed the expected decrease of the cell parameters, since the atomic radius of Y is smaller than the atomic radius of Sr. The existence of seven three-phase fields (YCu-Sr-Y, YCu_2-Sr-YCu, YCu_2-SrCu-Sr, YCu_4-SrCu-YCu_2, YCu_4-$(Sr_{0.5}Y_{0.5})Cu_5$-SrCu, YCu_7-$(Sr_{0.5}Y_{0.5})Cu_5$-YCu_4, and Cu-$(Sr_{0.5}Y_{0.5})Cu_5$-YCu_7) was observed in the diagram (see Figs. 1 and 2*c*).

During the investigation of the interaction of the components in the system Sr-Cu-Bi the formation of the ternary compound SrCuBi was confirmed. The cell parameters of this hexagonal phase with a ~ 0.4619 nm, c ~ 0.8727 nm (average parameters; table 3) are in agreement with literature data [11]. This phase was observed in all synthesized three-phase samples, however the attempts to prepare single phase alloys were not successful. Moreover, significant shift in the composition

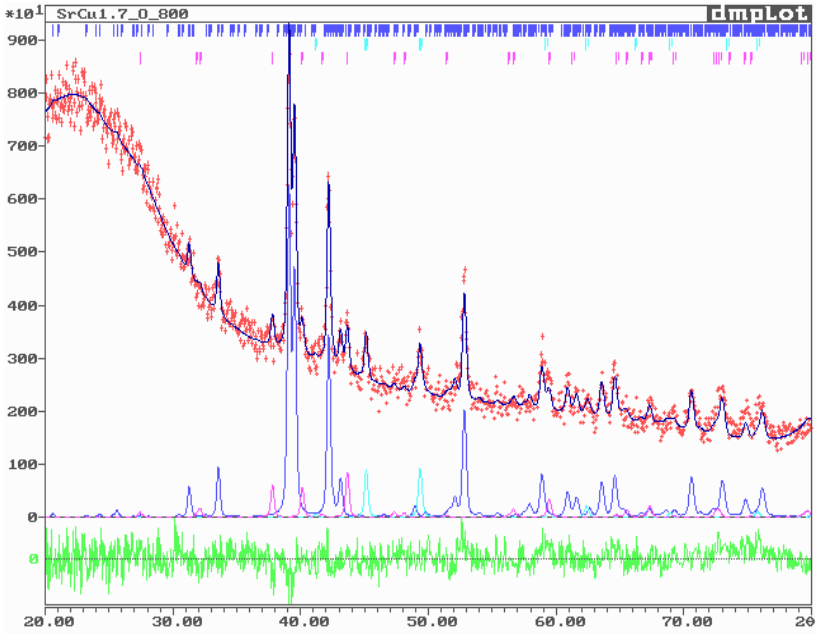

Fig. 5. Observed (crosses) and calculated (thick solid line) X-ray diffraction patterns of $SrCu_{1.7}$ sample oxidized at 800°C in air (Fe Kα radiation). The lower profile corresponds to the difference between observed and calculated data. The Bragg angle positions are indicated by vertical bars for $Sr_{14}Cu_{24}O_{41}$ (upper row), CuO (medium row) and $SrCuO_2$ (lower row).

Table 1

Results of the investigation of as cast binary alloys in the systems Y-Cu and Sr-Cu by scanning electron microscope (SEM) and X-ray diffraction

	Nominal sample composition	Sample composition from SEM (global)	Phase (composition from SEM on grains)	Structure type, Pearson symbol, space group	Cell parameters, nm		
					this work	literature	
1	$Y_{50.00}Cu_{50.00}$	$Y_{50.13}Cu_{49.87}$	YCu ($Y_{50.10}Cu_{49.90}$)	CsCl, *cP*2, *Pm*-3*m*	a = 0.3478(1)	a = 0.34757	[4]
2	$Y_{33.33}Cu_{66.67}$	$Y_{32.29}Cu_{67.71}$	YCu_2 ($Y_{34.06}Cu_{65.94}$)	KHg_2, *oI*12, *Imma*	a = 0.4303(1) b = 0.6869(1) c = 0.7291(1)	a = 0.4308 b = 0.6891 c = 0.7303	[5]
3	$Y_{22.22}Cu_{77.78}$	$Y_{22.34}Cu_{77.66}$	YCu_2 ($Y_{33.52}Cu_{66.48}$)	KHg_2, *oI*12, *Imma*	a = 0.4303(10) b = 0.6813(13) c = 0.7418(11)	a = 0.4308 b = 0.6891 c = 0.7303	[5]
			YCu_4 ($Y_{20.52}Cu_{79.48}$)	—	—	—	
4	$Y_{20.00}Cu_{80.00}$	$Y_{20.38}Cu_{79.62}$	YCu_4 ($Y_{20.08}Cu_{79.92}$)	—	—	—	
5	$Y_{16.67}Cu_{83.33}$	$Y_{16.69}Cu_{83.31}$	YCu_4 ($Y_{18.14}Cu_{81.86}$)	—	—	—	
			YCu_7 ($Y_{14.12}Cu_{85.88}$)	$TbCu_7$, *hP*8, *P*6/*mmm*	a = 0.4974(2) c = 0.4119(2)	a = 0.4940 c = 0.4157	[9]
6	$Y_{12.50}Cu_{87.50}$*	$Y_{15.65}Cu_{84.35}$	YCu_4 ($Y_{17.29}Cu_{82.71}$)	—	—	—	
			YCu_7 ($Y_{13.51}Cu_{86.49}$)	$TbCu_7$, *hP*8, *P*6/*mmm*	a = 0.4956(1) c = 0.4145(1)	a = 0.4940 c = 0.4157	[9]
7	$Y_{14.29}Cu_{85.71}$	$Y_{15.02}Cu_{84.98}$	YCu_7 ($Y_{15.06}Cu_{84.94}$)	$TbCu_7$, *hP*8, *P*6/*mmm*	a = 0.4979(1) c = 0.4136(1)	a = 0.4940 c = 0.4157	[9]
8	$Y_{14.29}Cu_{85.71}$*	$Y_{12.53}Cu_{87.47}$	YCu_7 ($Y_{14.00}Cu_{86.00}$)	$TbCu_7$, *hP*8, *P*6/*mmm*	a = 0.4981(1) c = 0.4116(1)	a = 0.4940 c = 0.4157	[9]
9	$Y_{10.00}Cu_{90.00}$	$Y_{10.52}Cu_{89.48}$	YCu_7 ($Y_{12.92}Cu_{87.08}$)	$TbCu_7$, *hP*8, *P*6/*mmm*	a = 0.4939(1) c = 0.4156(1)	a = 0.4940 c = 0.4157	[9]
			Cu** ($Y_{10.00}Cu_{90.00}$)	*cF*4, *Fm*-3*m,* Cu	a = 0.3615(1)	a = 0.36078	[20]
10	$Sr_{16.7}Cu_{83.3}$	$Sr_{16.70}Cu_{83.30}$	$SrCu_5$ ($Sr_{16.95}Cu_{83.05}$)	$CaCu_5$, *hP*6, *P*6/*mmm*	a = 0.5189(1) c = 0.4083(1)	a = 0.5261 c = 0.4058	[3]
11	$Sr_{37}Cu_{63}$	$Sr_{41.29}Cu_{58.71}$	$SrCu_5$ ($Sr_{16.48}Cu_{83.52}$)	$CaCu_5$, *hP*6, *P*6/*mmm*	a = 0.5248(1) c = 0.4032(1)	a = 0.5261 c = 0.4058	[3]
			SrCu ($Sr_{49.30}Cu_{50.70}$)	BaCu, *hP*8, $P6_3/mmc$	a = 0.4326(1) c = 1.536(1)	a = 0.4341 c = 1.538	[2]
12	$Sr_{50}Cu_{50}$	**	SrCu	BaCu, *hP*8, $P6_3/mmc$	a = 0.4325(1) c = 1.537(1)	a = 0.4341 c = 1.538	[2]

*- sample prepared by arc-melting

**- impossible to polish the sample since high chemical activity in air

of this phase to a higher Bi content detected by microprobe analyses in different samples indicates off-stoichiometry and a certain homogeneity range. The existence of equilibria between SrCuBi, Bi and the binary compounds $Sr_{11}Bi_{10}$, Sr_2Bi_3, $SrBi_3$, SrCu and $SrCu_5$ was established. Considering a simple character of the phase relations in this system, the equilibria SrCuBi-Sr_4Bi_3, SrCuBi-$Sr_{16}Bi_{11}$, SrCuBi-Sr_5Bi_3, SrCuBi-Sr_2Bi, SrCu-Sr_2Bi and $SrCu_5$-Bi have been predicted and a schematic phase diagram of the system Sr-Cu-Bi is presented in Fig. 4.

Attempts to oxidize the pure SrCu phase (alloy ground into powder) in air at room temperature resulted in the immediate appearance of a black and almost amorphous powder. Some peaks could be indexed as corresponding to SrCu and $Sr(OH)_2(H_2O)$. The application of the same procedure to the two-phase sample $SrCu_{1.7}$ (Sr/Cu ratio equal to the Sr/Cu ratio in the $Sr_{14}Cu_{24}O_{41}$ spin-ladder cuprate) resulted in the oxidation of the SrCu phase alone, whereas the $SrCu_5$ phase remained stable. In addition this sample contained $Sr(OH)_2(H_2O)$ and $SrCO_3$. However, after oxidation of $SrCu_{1.7}$ sample at 500°C in air for 24 h, $SrCO_3$, CuO and small quantities of $Sr_{14}Cu_{24}O_{41}$ could be identified. In order to improve the conditions of formation of the $Sr_{14}Cu_{24}O_{41}$ cuprate, $SrCu_{1.7}$ powder was pressed into a pellet and oxidized in air at 600°C. In this case the content of $Sr_{14}Cu_{24}O_{41}$ phase was slightly higher but the formation of CuO, $SrCO_3$ and $SrCuO_2$ phases was still observed. Since the product of oxidation still contained $SrCO_3$ phase the temperature was increase up to 800°C. The diffraction pattern of this sample is shown in Fig. 5. It contains ~80 wt. % $Sr_{14}Cu_{24}O_{41}$ phase, ~10 wt. % CuO and ~10 wt. % $SrCuO_2$.

Table 2

Results of the investigation of as cast ternary alloys in the system Sr-Y-Cu (as-cast alloys) by scanning electron microscope (SEM) and X-ray diffraction

	Nominal sample composition	Sample composition from SEM (global)	Phase (composition from SEM on grains)	Structure type, Pearson symbol, space group	Cell parameters, nm		
					this work	literature	
1	$Sr_5Y_9Cu_{86}$	$Sr_{2.69}Y_{9.21}Cu_{88.10}$	$SrCu_5$(ss)*	$CaCu_5$, *hP*6, *P*6/*mmm*	*a* = 0.4999(1) *c* = 0.4110(1)	*a* = 0.5261 *c* = 0.4058	[3]
			YCu_7*	$TbCu_7$, *hP*8, *P*6/*mmm*	*a* = 0.4972(1) *c* = 0.4143(1)	*a* = 0.4940 *c* = 0.4157	[9]
			Cu	Cu, *cF*4, *Fm*-3*m*	*a* = 0.3606(1)	*a* = 0.36078	[20]
2	$Sr_{15}Y_5Cu_{80}$	$Sr_{19.55}Y_{5.49}Cu_{74.96}$	$SrCu_5$(ss) ($Sr_{11.92}Y_{8.3}Cu_{79.78}$)	$CaCu_5$, *hP*6, *P*6/*mmm*	*a* = 0.5138(1) *c* = 0.4070(1)	*a* = 0.5261 *c* = 0.4058	[3]
			SrCu ($Sr_{49.24}Cu_{50.76}$)	BaCu, *hP*8, $P6_3/mmc$	*a* = 0.4326(1) *c* = 1.536(1)	*a* = 0.4341 *c* = 1.538	[2]
3	$Sr_{16.7}Y_{8.3}Cu_{75}$	$Sr_{6.46}Y_{13.66}Cu_{79.88}$	YCu_4 ($Y_{18.75}Cu_{81.25}$)	—	—	—	
			$SrCu_5$(ss) ($Sr_{6.88}Y_{10.87}Cu_{82.25}$)	$CaCu_5$, *hP*6, *P*6/*mmm*	*a* = 0.5136(2) *c* = 0.4046(2)	*a* = 0.5261 *c* = 0.4058	[3]
			SrCu ($Sr_{46.89}Cu_{53.11}$)	BaCu, *hP*8, $P6_3/mmc$	*a* = 0.4326(5) *c* = 1.549(2)	*a* = 0.4341 *c* = 1.538	[2]
4	$Sr_{10}Y_{20}Cu_{70}$	$Sr_{2.75}Y_{23.99}Cu_{73.26}$	YCu_4 ($Y_{20.17}Cu_{79.83}$)	—	—	—	
			YCu_2 ($Y_{33.03}Cu_{66.97}$)	KHg_2, *oI*12, *Imma*	*a* = 0.4278(4) *b* = 0.6823(5) *c* = 0.7302(7)	*a* = 0.4308 *b* = 0.6891 *c* = 0.7303	[5]
			SrCu*	BaCu, *hP*8, $P6_3/mmc$	*a* = 0.4301(5) *c* = 1.530(3)	*a* = 0.4341 *c* = 1.538	[2]
5	$Sr_{20}Y_{25}Cu_{55}$	$Sr_{1.06}Y_{33.97}Cu_{64.97}$	YCu_2 ($Y_{33.66}Cu_{66.34}$)	KHg_2, *oI*12, *Imma*	*a* = 0.4289(1) *b* = 0.6850(1) *c* = 0.7270(1)	*a* = 0.4308 *b* = 0.6891 *c* = 0.7303	[5]
			YCu ($Y_{52.22}Cu_{47.78}$)	CsCl, *cP*2, *Pm*-3*m*	*a* = 0.3462(1)	*a* = 0.34757	[4]
			Sr	Cu, *cF*4, *Fm*-3*m*	*a* = 0.6075(1)	*a* = 0.608	[20]
6	$Sr_{20}Y_{40}Cu_{40}$	$Sr_{3.97}Y_{48.88}Cu_{47.15}$	YCu ($Y_{51.24}Cu_{48.76}$)	CsCl, *cP*2, *Pm*-3*m*	*a* = 0.3467(1)	*a* = 0.3477	[4]
			Sr	Cu, *cF*4, *Fm*-3*m*	*a* = 0.6078(2)	*a* = 0.608	[20]
7	$Sr_{33.3}Y_{33.4}Cu_{33.3}$	—	YCu ($Y_{50.81}Cu_{49.19}$)	CsCl, *cP*2, *Pm*-3*m*	*a* = 0.3468(1)	*a* = 0.3477	[4]
			Sr	Cu, *cF*4, *Fm*-3*m*	*a* = 0.6075(1)	*a* = 0.608	[20]

*- small quantities

Acknowledgement

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Table 3

Results of the investigation of as cast ternary alloys in the system Sr-Cu-Bi by scanning electron microscope (SEM) and X-ray diffraction

	Nominal sample composition	Sample composition from SEM (global)	Phase (composition from SEM on grains)	Structure type, Pearson symbol, space group	Cell parameters, nm		
					this work	literature	
1	$Sr_{25}Cu_{70}Bi_5$	$Sr_{20.73}Cu_{79.14}Bi_{0.13}$	$SrCu_5$ ($Sr_{16.73}Cu_{83.27}$)	$CaCu_5$, *hP*6, *P*6/*mmm*	*a* = 0.5248(1) *c* = 0.4040(1)	*a* = 0.5261 *c* = 0.4058	[3]
			SrCu ($Sr_{50.22}Cu_{49.78}$)	BaCu, *hP*8, $P6_3/mmc$	*a* = 0.4324(1) *c* = 1.537(1)	*a* = 0.4341 *c* = 1.538	[2]
			SrCuBi*	ZrBeSi, *hP*6, $P6_3/mmc$	*a* = 0.4626(2) *c* = 0.8775(8)	*a* = 0.462 *c* = 0.884	[11]
2	SrCuBi	$Sr_{40.36}Cu_{16.90}Bi_{42.74}$	SrCuBi ($Sr_{30.3}Cu_{31.7}Bi_{38.0}$)	ZrBeSi, *hP*6, $P6_3/mmc$	*a* = 0.4618(1) *c* = 0.8752(1)	*a* = 0.462 *c* = 0.884	[11]
			Sr_2Bi_3 ($Sr_{39.2}Bi_{60.8}$)	Sr_2Bi_3, *oP*20, *Pnna*	—*	*a* = 1.5631; *b* = 0.6793 *c* = 0.6599	[17]
			$Sr_{11}Bi_{10}$ ($Sr_{50.7}Bi_{49.3}$)	$Ho_{11}Ge_{10}$, *tI*84, *I*4/*mmm*	*a* = 1.275(1) *c* = 1.838(1)	*a* = 1.2801 *c* = 1.8451	[17]
3	SrCuBi	$Sr_{36.34}Cu_{18.83}Bi_{44.83}$	SrCuBi ($Sr_{36.8}Cu_{28.3}Bi_{34.9}$)	ZrBeSi, *hP*6, $P6_3/mmc$	*a* = 0.4614(1) *c* = 0.8748(1)	*a* = 0.462 *c* = 0.884	[11]
			Sr_2Bi_3 ($Sr_{38.7}Bi_{61.3}$)	Sr_2Bi_3, *oP*20, *Pnna*	—*	*a* = 1.5631 *b* = 0.6793 *c* = 0.6599	[17]
			$Sr_{11}Bi_{10}$ ($Sr_{50.6}Bi_{49.4}$)	$Ho_{11}Ge_{10}$, *tI*84, *I*4/*mmm*	*a* = 1.275(1) *c* = 1.838(1)	*a* = 1.2801 *c* = 1.8451	[17]
4	$Sr_{20}Cu_{40}Bi_{40}$	$Sr_{24.72}Cu_{22.41}Bi_{52.87}$	SrCuBi ($Sr_{23.20}Cu_{36.36}Bi_{40.44}$)	ZrBeSi, *hP*6, $P6_3/mmc$	*a* = 0.4616(1) *c* = 0.8742(2)	*a* = 0.462 *c* = 0.884	[11]
			$SrBi_3$ ($Sr_{24.28}Bi_{75.72}$)	$AuCu_3$, *cP*4, *Pm*-3*m*	*a* = 0.5027(1)	*a* = 0.5042	[12]
			Bi	As, *hR*6, *R*-3*m*	*a* = 0.4525(1) *c* = 1.184(1)	*a* = 0.45330 *c* = 1.1797	[20]
5	$Sr_{20}Cu_{10}Bi_{70}$	$Sr_{19.06}Cu_{11.47}Bi_{69.47}$	SrCuBi ($Sr_{21.77}Cu_{30.95}Bi_{47.28}$)	ZrBeSi, *hP*6, $P6_3/mmc$	*a* = 0.4620(3) *c* = 0.8616(9)	*a* = 0.462 *c* = 0.884	[11]
			$SrBi_3$ ($Sr_{24.20}Bi_{75.80}$)	$AuCu_3$, *cP*4, *Pm*-3*m*	*a* = 0.5027(1)	*a* = 0.5042	[12]
			Bi	As, *hR*6, *R*-3*m*	*a* = 0.4529(1) *c* = 1.182(1)	*a* = 0.45330 *c* = 1.1797	[20]

*- small quantities

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Взаємодія компонентів у системах Sr-Y-Cu та Sr-Cu-Bi

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Діаграми стану потрійних систем Sr-Y-Cu і Sr-Cu-Bi побудовано схематично за результатами дослідження сплавів у литому стані. У першому випадку сім трифазних полів формується в системі. Тернарні сполуки не утворюються. На основі бінарної сполуки $SrCu_5$ зі структурою типу $CaCu_5$ утворюється протяжний твердий розчин. У потрійній системі Sr-Cu-Bi підтверджено існування тернарної сполуки SrCuBi. Встановлено фазові рівноваги між цією сполукою та сполуками у відповідних подвійних системах. Окиснення зразка складу $SrCu_{1,7}$ на повітрі при температурі 800°C привело до утворення більше ніж 80 мас. % фази $Sr_{14}Cu_{24}O_{41}$.