Table 1
Crystallographic data of the ternary compounds in the ternary system Er–Ni–B

No.	Compound	Space group	Structure type	Lattice parameters				Reference
				a (nm)	b (nm)	c (nm)	β (°)	
1	$Er_3Ni_{13}B_2$	*P6/mmm*	$Nd_3Ni_{13}B_2$	0.4938	–	1.090		[1]
[a]	$Er_{0.917}Ni_{4.09}B$	*P6/mmm*	$Er_{0.917}Ni_{4.09}B$	1.48399		0.6919		[13]
2	$ErNi_4B$	*P6/mmm*	$CeCo_4B$	0.4949	–	0.6931		[1]
3	$Er_3Ni_7B_2$	$P6_3/mmc$	$Dy_3Ni_7B_2$	0.5060	–	1.4276		[1]
[a]	$\sim ErNi_8B_2$	–	Unknown	–	–	–		[b]
4	$Er_2Ni_{21}B_6$	*Fm3m*	$W_2Cr_{21}C_6$	1.0640	–	–		[1]
5	$ErNi_7B_3$	$I4_1/amd$	$ErNi_7B_3$	0.7665	–	1.5584		[13]
6	$\sim ErNi_{6.5}B_3$	cubic	Unknown	0.7735 (3)	–	–		[b]
7	$Er_2Ni_{10}B_5$	*Pbca*	$Ho_2Ni_{10}B_5$	1.7545	0.8977	0.9441		[6]
8	$Er_3Ni_{19}B_{10}$	*C2/m*	$Ho_3Ni_{19}B_{10}$	1.3101	0.8674	0.5761	91.05	[7]
9	$Er_2Ni_{15}B_9$	*Cmca*	$Ho_2Ni_{15}B_9$	1.5874	1.1561	1.1235		[4]
10	$ErNi_2B_2$	*C2/c*	$HoNi_2B_2$	0.8345	0.5188	0.6887	126.60	[5]
11	$Er_2Ni_3B_6$	*Cmmm*	$Lu_2Ni_3B_6$	0.7701	0.8632	0.3462		[3]
12	$ErNiB_4$; LTM	*Pbam*	$YCrB_4$	0.5792	1.1544	0.3435		[14]
	$ErNiB_4$; HTM	*I4/mmm*	$ErNiB_4$	0.7505	–	0.8496		[13]
13	Er_4NiB_{13}	*P4/mnc*	Er_4NiB_{13}	0.7186	–	0.7446		[1]

[a] Compounds were found only in the as-cast samples.
[b] Data of our investigation.

The formation of solid solution regions for the binary compounds was not revealed, and practically no variation of the lattice parameters of the ternary borides in two- and three-phase samples was observed (Table 2). This fact indicates that no homogeneity ranges exist for the ternary compounds.

The ternary compounds Ln_2NiB_{10} where Ln–Y, Gd, Tb, Dy, Ho with the Th_2NiB_{10} structure type were reported in [12]. We prepared the sample of the composition Er_2NiB_{10} to verify the formation of the boride with the same structure in the Er–Ni–B system. But the powder diffraction pattern of this sample contained the lines of three binary compounds ($ErB_4 + ErB_{12} + NiB$), which indicates the absence of the ternary boride Er_2NiB_{10} in the Er–Ni–B system (Table 2).

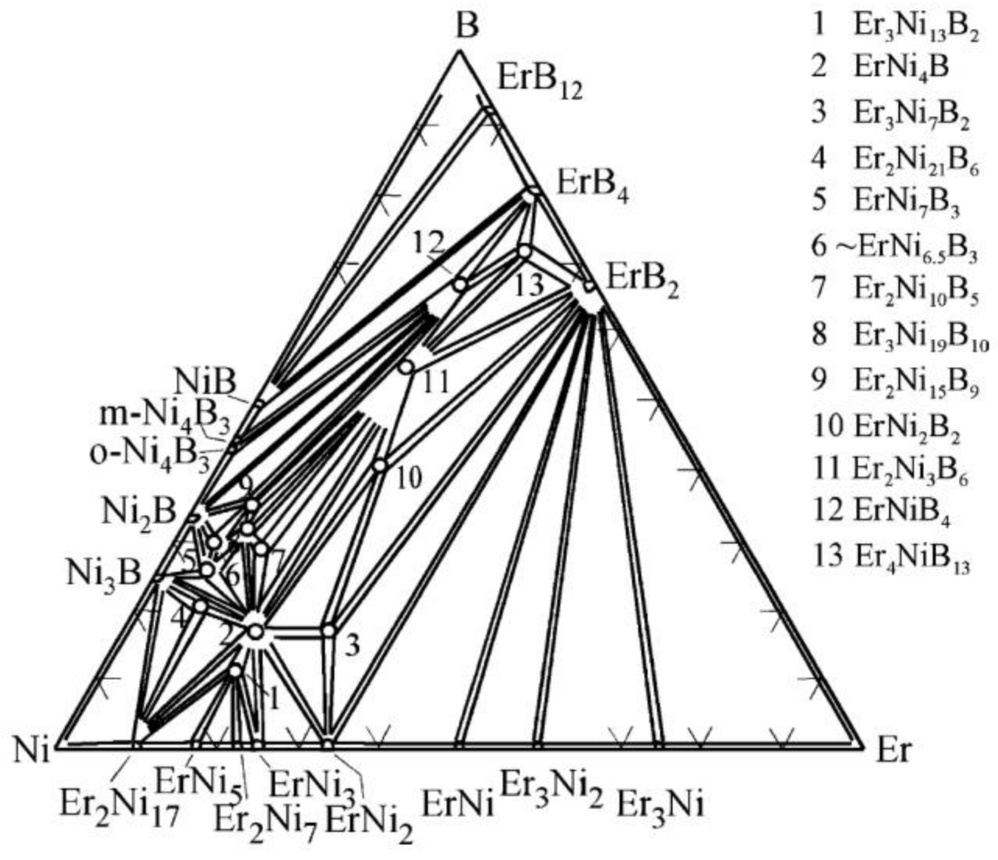

Fig. 1. The phase diagram of the ternary system Er–Ni–B at 1070 K.

A compound of the composition $ErNiB_4$ was reported to crystallize with two different structures: $ErNiB_4$ [13] and $YCrB_4$ [14]. This can indicate the existence of polymorphism for this boride. Taking into account that the boride with the $ErNiB_4$ type structure was found by a single-crystal method, and that the boride with the $YCrB_4$ type structure was found by X-ray powder diffraction, we assumed the high-temperature modification to have the $ErNiB_4$ structure and the low-temperature modification to have the $YCrB_4$ structure. The results of a DTA investigation revealed a transition temperature of 1540 K.

A new compound of the approximate composition $ErNi_8B_2$ with unknown structure was found. The X-ray powder pattern of this compound differed from the powder patterns of the known ternary borides found in the earlier studied Ln–Ni–B systems. This compound exists only in the as-cast sample and decomposes into the $Er_2Ni_{21}B_6$ and $ErNi_4B$ compounds after annealing. Since the single crystals were not available its structure was not determined.

A further new compound was found in the as-cast samples containing 16.6 at.% Er. The X-ray powder pattern of this compound was very similar to the powder pattern of the $ErNi_4B$ boride. The crystal structure of the new $Er_{0.917}Ni_{4.09}B$ boride was determined using an X-ray single-crystal method: space group *P6/mmm*; $a = 1.48399$ nm; $c = 0.69194$ nm [15]. This structure is very similar to the $Y_{0.915}Ni_{4.12}B$ structure [16]. The $Er_{0.917}Ni_{4.09}B$ boride decomposes after annealing, and the main phase is the $ErNi_4B$ compound.

According to our data, the $Er_4Ni_{29}B_{10}$ boride has the correct composition $ErNi_7B_3$: space group $I4_1/amd$; $a =$