NEW TERNARY COMPOUND $GdMn_{1-x}Zn_{1+x}$, $-0.075 \le x \le 0.075$

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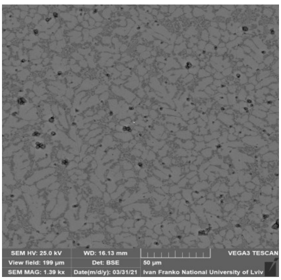
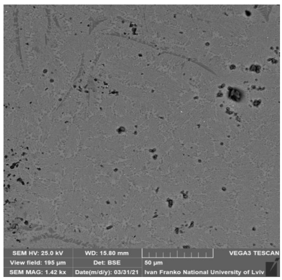
Systematic investigation of the ternary system Gd–Mn–Zn is driven by a practical interest in this type of systems due to their possible application as hydrogen sorption materials and electrode materials for NiMH-batteries. Previous studies revealed the formation of few solid solutions on the basis of binary phases with homogeneity ranges not exceeding 5 at. % and three new ternary compounds – $Gd_2Mn_3Zn_{14}$ with Th_2Zn_{17}-type structure (space group *R*-3*m*) [1]), $GdMn_{1.075-0.925}Zn_{0.925-1.075}$ and ~$Gd_{23(1)}Mn_{46(1)}Zn_{31(1)}$ with unknown crystal structures and slight homogeneity ranges. Solid solutions on the basis of $GdMn_2$ demonstrated hydrogen sorption ability [2].

Samples of alloys were synthesized by arc melting of pure metals (5 wt. % excess of Mn and Zn) under a purified argon atmosphere. The alloys were remelted one time for better homogenization and annealed at 500° C for two months. X-ray phase analysis and energy dispersive X-ray spectroscopy (Tescan VEGA3 LMU microscope, EDX-analyzer with X-Max^{N}20 detector) showed the formation of a new compound $GdZn_{1-x}Mn_x$ (**Fig.**). For instance, the alloy $Gd_{33.3}Mn_{33.3}Zn_{33.3}$ contained two phases – a solid solution $GdZn_{1-x}Mn_x$ and a ternary compound $GdMn_{1-x}Zn_{1+x}$. The alloy $Gd_{33}Mn_{27}Zn_{40}$ contained three phases – a solid solution $GdZn_{1-x}Mn_x$, a ternary compound $GdMn_{1-x}Zn_{1+x}$ and an unknown ternary phase of preliminary composition ~$Gd_{23(1)}Mn_{46(1)}Zn_{31(1)}$. The refinement of the crystal structure of $GdMn_{1-x}Zn_{1+x}$, $-0.075 \le x \le 0.075$ from powder data by least square procedure proved that it crystallizes in a hexagonal $CaIn_2$-type structure (space group $P6_3/mmc$, a = 4.192(2) Å, c = 7.08(1) Å, V = 107.8 (1) Å^3). Investigation of the hydrogen sorption and electrochemical properties of this compound will be a topic of our further studies.



Light grey phase – $Gd_{48.1(5)}Mn_{5.1(8)}Zn_{46.8(7)}$;
Grey phase – $Gd_{34.1(3)}Mn_{32.8(6)}Zn_{33.1(9)}$

a



Light grey phase – $Gd_{48.1(3)}Mn_{4.0(7)}Zn_{47.9(7)}$;
Grey phase – $Gd_{34.4(4)}Mn_{30.9(7)}Zn_{34.7(7)}$;
Dark grey phase – $Gd_{23(1)}Mn_{46(1)}Zn_{31(1)}$

b

Fig. SEM-images (BSE-mode) of $Gd_{33.3}Mn_{33.3}Zn_{33.3}$ (*a*) and $Gd_{33}Mn_{27}Zn_{40}$ (*b*) alloys

[1] N. Chorna, O. Zelinska, G. Dmytriv, V. Pavlyuk, A. Zelinskiy, V. Kordan, A. Mar. *Coll. Abs. XIV Int. Conf. Cryst. Chem. Intermet. Compd.* Lviv, September 22-26, 2019. P. 119.

[2] N.O. Chorna, V.M. Kordan, A.M. Mykhailevych, O.Ya. Zelinska, A.V. Zelinskiy, K. Kluziak, R.Ya. Serkiz, V.V. Pavlyuk. *Vopr. Khim. Khim. Tekhnol.* 2 (2021) 139-149.