

ELECTROCHEMICAL HYDROGENATION OF Tb₂Ni_{7-x}M_x (M = Al, Ga) COMPOSITES

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For R_2M_7 (R = rare-earth metal, M = Fe, Co, Ni, Zn) intermetallic compounds or multicomponent solid solutions based on them polymorphism is often characteristic. For example, for Tb₂Ni₇ structural transition from hexagonal Ce₂Ni₇ to rhombohedral Gd₂Co₇ at 931 °C is known [1]. Both polymorph modifications mainly dissolve Li, Mg, or some p -elements approximately in equal quantities. The hydrogen sorption properties are inherent to these phases.

Samples with the nominal composition Tb₂₂Ni₇₃M₅ (M = Al, Ga) were synthesized by arc melting, than remelted several times for better homogenization and annealed at 673 K for two months. X-ray phase analysis and scanning electron microscopy showed that the samples consisted of three phases with similar crystal structures: the major content of α -Tb₂Ni_{7-x}M_x (space group $P6_3/mmc$), and minor content of β -Tb₂Ni_{7-x}M_x (space group $R-3m$) and TbNi_{5-x}M_x (space group $P6/mmm$). Energy dispersive X-ray spectroscopy (Tescan VEGA3 LMU microscope, EDX-analyzer with X-Max^N20 detector) confirmed the formation of these phases. At Fig. we can see that elemental distribution for the main solution based on the α -Tb₂Ni_{6.5}M_{0.5} is homogeneous. Cell parameters of ternary phases α -Tb₂Ni_{6.5}Al_{0.5} and α -Tb₂Ni_{6.2}Ga_{0.5} are: $a = 4.9654(6)$ Å, $c = 24.280(4)$ Å, $V = 518.4(1)$ Å³ and $a = 4.9586(5)$ Å, $c = 24.165(2)$ Å, $V = 514.57(8)$ Å³, respectively. These values correlate well with cell parameters of binary α -Tb₂Ni₇ phase ($a = 4.9498(3)$, $c = 24.126(3)$, $V = 511.93(7)$ Å³ [1]). Electrochemical hydrogenation of the studied alloys was carried out in Swagelok-type battery prototype. Specific discharge capacities for battery prototype with Tb₂₂Ni₇₃M₅ (M = Al and Ga) alloys as electrodes are 159 and 154 mA·h/g, respectively.

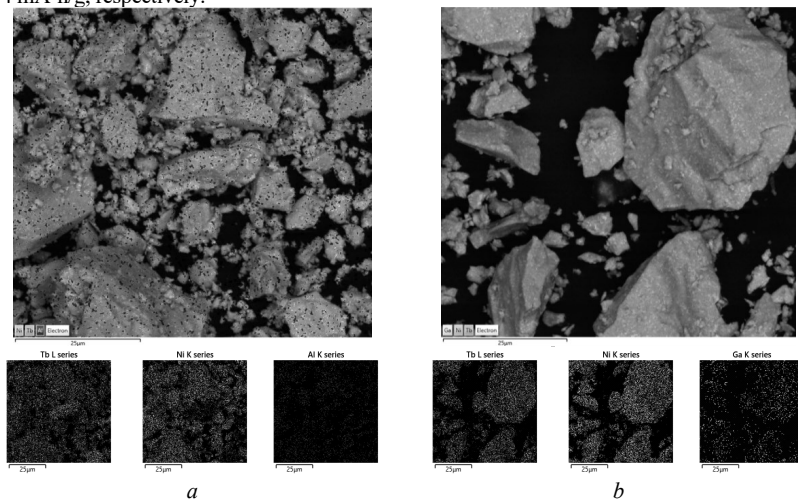


Fig. Elemental mapping of powders Tb₂₂Ni₇₃Al₅ (a) and Tb₂₂Ni₇₃Ga₅ before hydrogenation (b)

[1] *Nytka V., Kordan V., Tarasiuk I., Zelinska O., Pavlyuk V.* Polymorphism of the Tb₂Ni₇ binary compound. Solubility of lithium and magnesium in α -phase // Visnyk Lviv Univ. Ser. Chem. 2022. Vol. 63. P. 74–81. (in Ukrainian).