NEW COMPOSITE BASED ON $Tb_{2-x}Y_xNi_{7-y}Mg_y$ AND $Tb_{1-x}Y_xNi_{5-y}Mg_y$ PHASES WITH HYDROGEN SORPTION PROPERTIES

Nytka V., Kordan V., Voloshyn V., Tarasiuk I., Pavlyuk V.
Department of Inorganic Chemistry, Ivan Franko National University of Lviv,
6 Kyryla i Mefodiya St., 79005 Lviv, Ukraine
vitalii.nytka@lnu.edu.ua

Systematic studies of the $R_2Ni_{7-x}M_x$ solid solutions often showed the presence of two polymorphs in alloys. Both these phases mainly dissolve Mg or some *p*-elements approximately in equal quantities. The room-temperature modification α-Tb_2Ni_7 crystallizes in the hexagonal Ce_2Ni_7-type; the high-temperature phase β-Tb_2Ni_7 belongs to the rhombohedral Gd_2Ni_7-type. The hydrogen sorption properties are inherent to these phases.

A sample with the nominal composition $Tb_{1.5}Y_{0.5}Ni_{6.5}Mg_{0.5}$ was synthesized by arc melting of a pressed pellet containing a mixture of pure metals (5 wt. % excess of Mg). The alloy was remelted several times for better homogenization and annealed at 673 K for two months. X-ray phase analysis showed that the sample consisted of three phases with similar crystal structures: α-$Tb_{2-x}Y_xNi_{7-y}Mg_y$ (space group $P6_3/mmc$, a = 4.9579(4) Å, c = 24.156(5) Å, V = 514.2(1) Å^3), β-$Tb_{2-x}Y_xNi_{7-y}Mg_y$ (space group $R\text{-}3m$, a = 4.9505(8) Å, c = 36.241(6) Å, V = 769.2(2) Å^3) and $Tb_{1-x}Y_xNi_{5-y}Mg_y$ (space group $P6/mmm$, a = 4.8839(6) Å, c = 3.9473(6) Å, V = 81.54(2) Å^3). A solid solution with a stoichiometry of 1:5 crystallizes in the $CaCu_5$ structure, which is related to the Ce_2Ni_7- and Gd_2Ni_7-types. Energy dispersive X-ray spectroscopy (Tescan VEGA3 LMU microscope, EDX-analyzer with X-Max^{N}20 detector) confirmed the formation of these phases (Fig.). Electrochemical hydrogenation of the studied alloy was carried out in Swagelok-type battery prototype. The $Tb_{1.5}Y_{0.5}Ni_{6.5}Mg_{0.5}$ sample demonstrated a good reversible hydrogen sorption ability as a negative electrode in the battery. We also observed the corrosion stability of the electrode in the alkaline medium of the electrolyte (6M KOH solution).

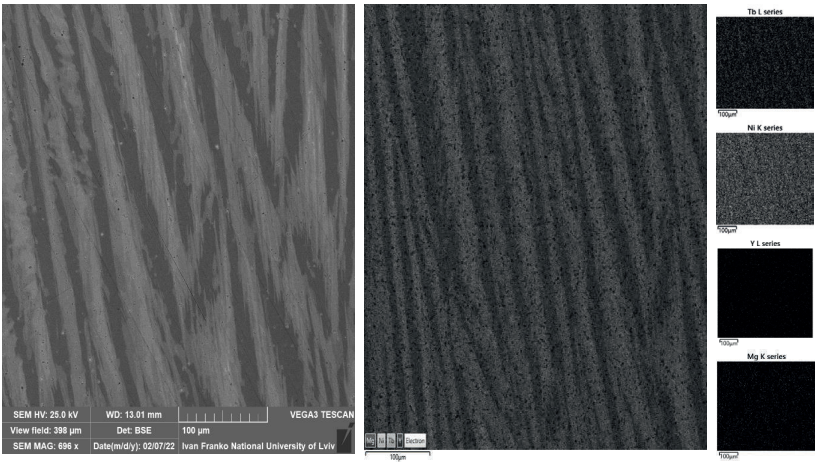

Figure. SEM-image (BSE-mode) (left) and elemental mapping (right) of the $Tb_{15.5}Y_5Ni_{74.5}Mg_5$ alloy. Integral composition – $Tb_{14.9}Y_{3.7}Ni_{76.5}Mg_{4.9}$, dark phase – $Tb_{12.5}Y_{3.2}Ni_{81.0}Mg_{3.3}$, light phase – $Tb_{15.6}Y_{4.1}Ni_{74.5}Mg_{5.8}$

Funding for this research was provided by grant No. 0121U107937.