COMPOSITE BASED ON THE Y_2Ni_{17}:Mg,Ti AND $Ca_{0.5}Dy_{0.5}MnO_3$ OXIDE AS HYDROGEN SORPTION MATERIAL

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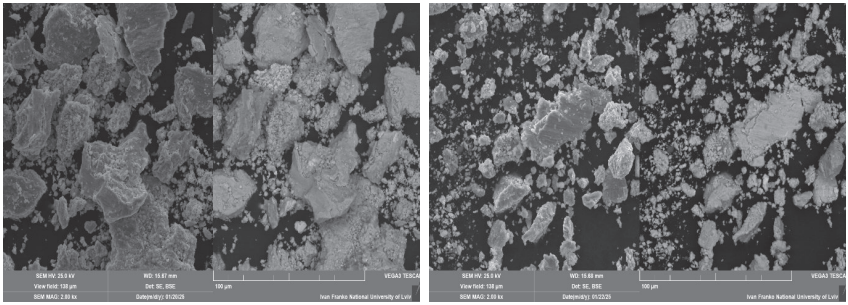
Hydrogen energetics is one of the most promising areas in the modern industry. Materials for hydrogen accumulation in the form of hydrides of intermetallic compounds or composites are attractive and prospective. These materials have different crystal structures and chemical compositions and most of them derive from the $CaCu_5$ (space group *P*6/*mmm*) parent type. For example, the Th_2Ni_{17} structure type (space group $P6_3/mmc$) is related to $CaCu_5$-type and has similar voids in the structure suitable to incorporate hydrogen atoms.

Alloy with the nominal composition $Y_8Ti_{2.5}Ni_{87}Mg_{2.5}$ was synthesized by arc melting (excess of Mg 10 wt. %) and was remelted several times for better homogenization. Energy dispersive X-ray spectroscopy (Tescan VEGA3 LMU microscope, EDX-analyzer with X-Max^{N}20 detector) confirmed the chemical composition of observed phases. X-ray phase analysis and scanning electron microscopy showed that the sample consisted of two phases: the main phase based on the solid solution Y_2Ni_{17}:Mg,Ti ($Y_{7.9}Ti_{3.1}Ni_{86.6}Mg_{2.4}$, space group $P6_3/mmc$) and small amount of Ni ($Ni_{98.5}Y_{0.2}Ti_{1.3}$, space group *Fm*-3*m*). Oxide phase with $GdFeO_3$-type structure (space group *Pnma*) was synthesized by solid-state reaction from carbonate ($CaCO_3$) and oxide (Dy_2O_3 and Mn_2O_3) powders in two stages at 1273 and 1473 K. The duration of stages was 24 and 8 h, respectively. Microcrystallites of ceramics had size from 250 to 600 nm.

Solid solution Y_2Ni_{17}:Mg,Ti can be interpreted as $Y_{2-y-z}Ti_yNi_{17-x}Mg_{x+z}$ with a complex mechanism of substitution, where the positions of yttrium are partially occupied by Ti and Mg atoms and nickel is replaced by Mg atoms. The $Y_8Ti_{2.5}Ni_{87}Mg_{2.5}$ alloy and oxide phase (5 wt. %) were mixed and thoroughly ground for 2 hours for the composite preparation. Composite with the composition Y_2Ni_{17}:Mg,Ti/$Ca_{0.5}Dy_{0.5}MnO_3$ showed the hydrogen-sorption ability. The efficiency of the electrochemical hydrogenation of composite was investigated in two-electrode Swagelok-type prototype. The addition of ceramics reduces the etching of the metallic phase surface (Fig.) and increases the hydrogen sorption characteristics.



(a) as-cast *(b) after hydrogenation*

Fig. SEM-images of composite Y_2Ni_{17}:Mg,Ti/$Ca_{0.5}Dy_{0.5}MnO_3$ at 2000x magnification before (*a*) and after (*b*) hydrogenation

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