

# SYNTHESIS AND ELECTROCHEMICAL HYDROGENATION OF THE $\text{Tb}_2\text{Co}_{16}\text{Mg}_{0.5}\text{Al}_{0.5}$ PHASE

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Hexagonal structure type  $\text{Th}_2\text{Ni}_{17}$  ( $hP38$ ,  $P6_3/mmc$ ) is a derived type of the  $\text{CaCu}_5$  ( $hP6$ ,  $P6/mmm$ ) structure, which is formed by tripling of the cell with the replacement of one large rare-earth metal atom by two smaller transition metal atoms. Successful electrochemical hydrogenation of compounds based on terbium and 3d-transition metals belonging to  $\text{Th}_2\text{Ni}_{17}$  structure type has been previously reported. Partial replacement of cobalt with other elements leads to improved hydrogen adsorption properties.

The sample with nominal composition  $\text{Tb}_2\text{Co}_{16}\text{Mg}_{0.5}\text{Al}_{0.5}$  was synthesized by arc melting of pressed pellet containing a mixture of pure metals (5 wt. % excess of Mg) on a water-cooled copper hearth in purified argon atmosphere and was remelted several times to reach better homogenization. X-ray diffraction (XRD) powder pattern (DRON-2.0M, Fe  $K\alpha$ -radiation) showed the existence of two hexagonal phases with similar crystal structures. Lattice parameters for the main phase  $\text{Tb}_2\text{Co}_{17-x-y}\text{Mg}_x\text{Al}_y$  are  $a = 8.404(2)$  Å,  $c = 8.121(2)$  Å,  $V = 496.7(2)$  Å<sup>3</sup>. Lattice parameters for the second phase  $\text{TbCo}_{5-x-y}\text{Mg}_x\text{Al}_y$  are  $a = 4.9454(4)$  Å,  $c = 3.9891(5)$  Å,  $V = 84.49(1)$  Å<sup>3</sup>. The composition of the solid solution was confirmed by X-ray fluorescent spectroscopy (ElvaX Pro analyzer). The results of energy-dispersive X-ray spectroscopy (Tescan Vega3 LMU scanning electron microscope, Oxford Instruments AZtec ONE system) are fully consistent with the results of XRD and are as follows: integral composition:  $\text{Tb}_{12.8}\text{Co}_{80.5}\text{Mg}_{3.8}\text{Al}_{2.9}$ ; main phase:  $\text{Tb}_{11.1}\text{Co}_{80.8}\text{Mg}_{4.3}\text{Al}_{3.8}$ ; light spots (second phase):  $\text{Tb}_{17.5}\text{Co}_{77.6}\text{Mg}_{2.8}\text{Al}_{2.1}$ ; dark spots: oxides  $\sim \text{Tb}_2\text{O}_3 + \text{Co}$ .

The electrochemical studies were carried out in Swagelok-type two-electrode cell using MTech G410-2 galvanostat. The charge and discharge processes were performed in galvanostatic mode at  $1.0 \text{ mA/cm}^2$ . The investigated phase demonstrates the corrosion stability in the electrolyte solution (6 M KOH). Coulomb efficiency at 10-th discharge cycle reaches 95 %.

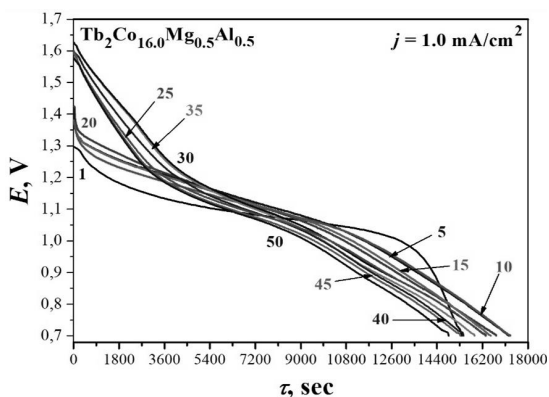
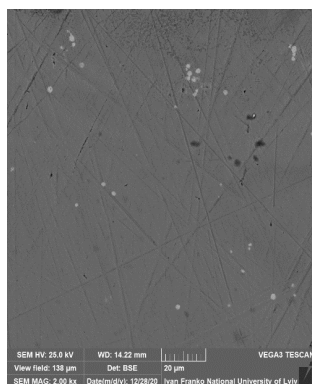


Fig. SEM-image (BSE-mode) of the  $\text{Tb}_2\text{Co}_{16}\text{Mg}_{0.5}\text{Al}_{0.5}$  alloy (left) and selected discharge curves for the Ni-MH battery prototype with the  $\text{Tb}_2\text{Co}_{16}\text{Mg}_{0.5}\text{Al}_{0.5}$ -based electrode (right)