

ELECTROCHEMICAL SYNTHESIS OF $\text{Li}_{x+y}\text{LaMgSn}_{1-y}$ AND $\text{Li}_x\text{LaMgSn}_2$ PHASES*Kordan V. M., Tarasiuk I. I., Zelinska O. Ya., Pavlyuk V. V.*

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The multicomponent alloys or intermetallic compounds are in the trend of modern research due their wide application in engineering and industry. Quite often the modification of the composition and structure by doping has a positive effect on the physical and chemical properties of the phases. In this work we investigated the effect of electrochemical intercalation/deintercalation of Li on the structure of intermetallic compounds LaMgSn and LaMgSn_2 .

The samples with the compositions $\text{La}_{33}\text{Mg}_{34}\text{Sn}_{33}$ and $\text{La}_{25}\text{Mg}_{25}\text{Sn}_{50}$ were synthesized by arc melting of the pressed mixture of pure metals with further annealing in Ta-crucibles in evacuated silica tubes at 673 K for 60 days. The X-ray phase analysis confirmed the formation of LaMgSn (structure type TiNiSi , space group $Pnma$) and LaMgSn_2 (own structure type, space group $I-42m$) as a major phase, and negligible amount of $\text{LaSn}_{3-x}\text{Mg}_x$ as a minor phase.

Electrochemical insertion of lithium into the crystal structure of the obtained phases was carried out in the Swagelok-type cell using the powder of synthesized alloy as a negative electrode and a powder of LiCoO_2 rhombohedral ceramics (NaFeO_2 -type) as a positive electrode. A separator soaked in electrolyte isolated the electrodes. The electrolyte consisted of $\text{Li}[\text{PF}_6]$ salt in a mixture of aprotic solvents (1:1 ethylene carbonate / dimethyl carbonate). All electrochemical measurements were carried out in galvanostatic mode.

As a result of lithium intercalation into the LaMgSn voids the lattice parameters of the phase decrease due to the formation of $\text{Li}_{x+y}\text{LaMgSn}_{1-y}$. After intercalation of lithium into the voids of LaMgSn_2 the solid solution of inclusion with a composition $\text{Li}_x\text{LaMgSn}_2$ is formed. The reason for this is strong covalent bonding Sn1-Sn1 which stabilize the anion framework. In this case the replacement of tin by lithium is unlikely. The lattice parameters of the solid solution $\text{Li}_x\text{LaMgSn}_2$ increase compare the initial phase. The results of the X-ray fluorescence and energy-dispersive X-ray spectroscopy confirm the reduction of the Sn content in the $\text{La}_{33}\text{Mg}_{34}\text{Sn}_{33}$ sample after lithiation. The formation of block-like aggregates (1–3 μm) of the particles with the size 300–600 nm was also observed (Fig.). Porous grains contain La, Mg, Sn from the alloys and also C, P, F from the electrolyte.

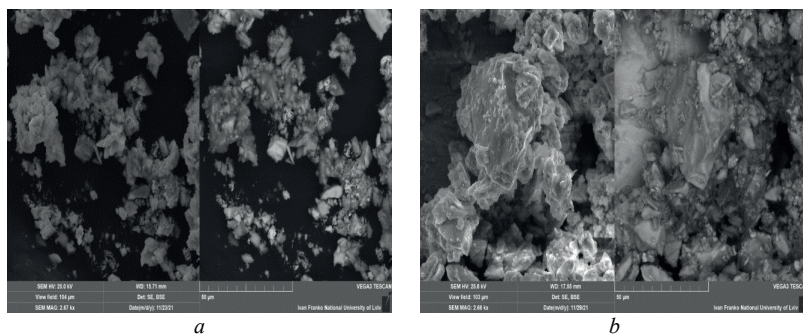


Figure. SEM-images (SE-, BSE-mode) of $\text{Li}_{x+y}\text{LaMgSn}_{1-y}$ (a, integral composition – $\text{Li}_x\text{La}_{34.1}\text{Mg}_{35.1}\text{Sn}_{30.8}$) and $\text{Li}_x\text{LaMgSn}_2$ (b, integral composition – $\text{Li}_x\text{La}_{24.2}\text{Mg}_{27.0}\text{Sn}_{48.8}$)

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