Brief information about the project

Title	AP22686263 «Enhancement of the diffusion properties of the magnesium-ion batteries anode material».
Relevance	The limited resource of lithium in the earth's crust may make it economically unviable in portable electronics. Therefore, the demand for alternative energy storage systems based on available materials is increasing. Magnesium-ion batteries are the best candidate as an alternative to lithium-ion batteries due to their ability to utilize abundant magnesium resources. Moreover, its main advantages such as high capacity and the absence of dendrite formation during cycling make it even more attractive for large-scale energy storage systems. However, the use of pure magnesium as an anode has a bad effect on the performance of MIB, which is associated with the formation of a passivating film on the electrode when interacting with electrolytes. To avoid this problem, it is necessary to replace magnesium metal with alternative electrode materials with high intercalation properties. This project uses titanium oxide, developed in a previous project, as an alternative anode electrode, the capacitance value of which is insufficient for commercial applications. In addition, there is a problem of insufficient diffusion rate of magnesium ions during intercalation/deintercalation, which thereby limits the practical application of magnesium ion batteries. Therefore, the main idea of this project is to find ways to improve the diffusion and capacitance properties of an anode based on titanium oxide. To implement this project, it is planned to use the most modern research methods and advanced equipment and instruments.
Goal	The goal of this project is to study diffusion processes during intercalation/deintercalation of magnesium ions to obtain a reversible anode material based on titanium oxide for magnesium-ion batteries.
Tasks	The following tasks are set during the project: - Selection of electrochemically active additives for introduction into the structure of anode material based on titanium oxide. - Synthesis of a composite anode doped with metals, improving ion diffusion and electron transport. - Preparation of a hybrid electrolyte based on chlorine-containing compounds for use in electrochemical intercalation processes. - Introduction of magnesium ions into composite materials to study their diffusion properties in the matrix. - Establishing patterns in the intercalation/deintercalation of magnesium into a composite anode using electrochemical methods and studying the influence of magnesium on the crystal structure, phase composition, and morphology of the modified anode using instrumental methods.

Expected and Achieved Results	- The synthesis of a composite anode doped with electrochemically active metals and the preparation of electrode material based on it for the intercalation of magnesium ions will be carried out. - Intercalation into the resulting composite anode material will be carried out and its electrochemical behavior will be studied in electrolyte solutions based on chlorine-containing compounds while varying the electrolyte concentration, scanning speed, and number of cycles. - The effect of magnesium on the crystal structure, phase composition, and morphology of the modified anode will be studied using physical and chemical methods. - The patterns of diffusion during the discharge/charge of an anode modified with electrochemically active metals will be established. - Based on the results of scientific work, it is planned 2 (two) articles will be published in journals from the first three quartiles by impact factor in the Web of Science database or having a CiteScore percentile in the Scopus database of at least 50. The results of the project will be published in the form of articles in the following journals: Electrochemistry Communications, IF – 5,4, Q1 (Electrochemistry), https://www.sciencedirect.com/journal/electrochemistry-communications Applied Sciences, IF – 2,7, Q1 (General Engineering), https://www.mdpi.com/journal/applsci
Names and Surnames of Research Group Members with Their Identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and Links to Corresponding Profiles	Джуманова Райгуль Жумахановна h-индекс: 1, ORCID: 0000-0003-3826-3474, Scopus author ID: 57188622123, Web of Science ResearcherID AAS-6004-2020. Аргимбаева Акмарал, кандидат химических наук, ассоцированный профессор h-индекс: 3 ResearcherID: AAQ-3743-2020 ORCID: 0000-0002-2467-8241 Scopus Author ID: 56436828200
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