

SYNTHESIS AND CHARACTERIZATION OF HIGHLY CONDUCTIVE NANOCRYSTALLIZED ϵ -LiVOPO₄ LIKE GLASSES

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In recent decades, significant developments have been observed in mobile electronics as well as renewable energy sources. For each of these applications, it is required that electrochemical cells exhibit the best possible performance parameters. Unfortunately, one of the main factors limiting the potential of contemporary electrochemical batteries is the low electrical conductivity of the cathode material, which impacts both the value and retention of gravimetric capacity under high discharge currents.

Vanadate-phosphates are a broad group of materials that have been studied for years for use as a cathode in lithium-ion cells. One of the more promising materials investigated in recent years is the triclinic phase ϵ -LiVOPO₄. For example, M. S. Whittingham's group showed that a test cell based on a cathode of ϵ -LiVOPO₄ has a gravimetric capacity of about 200 mAh/g at a discharge current of C/10, and this capacity decreases to 100-150 mAh/g with a 20-fold increase in discharge current (to 2C current) [1]. Other experimental works [2] show that the capacity of such cells decreases by about 25% after 50 charge-discharge cycles. This indicates that the technology for producing this material is still imperfect. One method to improve the properties of such materials is the thermal nanocrystallization of glasses [3]. This method has previously been used to increase conductivity in materials such as LiFePO₄ [4] or 90 V₂O₅ · 10 P₂O₅ [5].

Therefore, in this work we aimed at obtaining a glassy analog of LiVOPO₄ using the melt-quenching method. Thermal analysis was used to investigate the thermal stability of the pristine glass and identify temperatures of glass transition and crystallization. The process of nanocrystallization was observed in-situ by high-temperature X-ray diffractometry in inert gas flow – confirming appearance of the desired LiVOPO₄ phase. The maximum temperature of thermal nanocrystallization was optimized to increase the electrical conductivity as much as possible, namely to at least 10⁻⁶ S/cm at room temperature.

Acknowledgements

This work was supported by the National Science Centre (NCN, Poland) through OPUS-23 grant no. 2022/45/B/ST5/04005.

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