mESC-IS2022

6th International Symposium on Materials for Energy Storage and Conversion

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BOOK OF ABSTRACTS

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WELCOME NOTE

The 6th International Symposium on Materials for Energy Storage and Conversion
(mESC-IS 2022)

The committee would like to welcome you to the 6th International Symposium on Materials for Energy Storage and Conversion (mESC-IS 2022). This event is hosted by Faculty of electrical engineering, mechanical engineering and naval architecture, University of Split, Croatia.
mESC-IS 2022 is held in Bol, island of Brač, Croatia on July 5th to July 8th, 2022, in a hybrid mode.

The 6th International Symposium on Materials for Energy Storage and Conversion (mESC-IS 2022) is a multi-disciplinary international conference aiming to provide a long-term sharing of knowledge and discussions of highly actual issues in the field. The purpose is to bring together people from academic, industry and government organizations to exchange ideas and strengthen cooperation. The symposium will provide a forum for discussion in recent progress made in three major activity areas, namely batteries, solid state hydrogen storage and fuel cells. The symposium will have a fair balance of plenary sessions covering cross-cutting issues and the state-of-the-art reviews and parallel sessions with contributed papers and poster presentation.

On behalf of the committee, we would like to thank the members of the organizational and scientific committees, the reviewers, the session chairs, the authors, and all of you who attend the conference. We wish you four days of interesting and fruitful discussions.

Sincerely Yours,

mESC-IS 2022 Committee

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Vanadyl phosphate as a host material for aluminium intercalation

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The development of safe, durable, cheap, and environmentally friendly batteries is one of the most important challenges of modern electrochemistry. Hence, there is an interest in the investigation of aqueous batteries with multivalent ions such as calcium, magnesium, or aluminium. Furthermore, the use of polyanionic compounds as cathode material can provide multi-electron transport. $VOPO_4 \cdot 2H_2O$ with its layered structure is a particularly interesting and promising material.

The current study is focused on the investigation of $VOPO_4 \cdot 2H_2O$ as cathode material in aluminium aqueous rechargeable cells. According to the literature data, the conventional reflux method is mostly used for the material's synthesis [1]. Here is presented a sonochemical synthesis as a less time- and energy-consuming method, that starts from the mixture of vanadium(V)-oxide, phosphoric acid and water as a reaction media. The synthesis is done within 20 min.

The characterization of the synthesized material includes X-ray powder diffraction (XRD), scanning electron microscopy (SEM), Fourier transform infrared (FTIR) spectroscopy and cyclovoltammetry (CV).

XRD data were used for both the powders' phase identification and crystal structure refinement. The structure of the powder was refined in the tetragonal space group P4/nmmZ (No. 129). Crystal structure refinement was based on the Rietveld full profile method [2]. The structure is characterized by infinite layers of PO_4 tetrahedra linked to VO_6 octahedra by shared oxygen atoms that form 2D sheets in the *ab*-planes; water molecules are located in the interlayer space. The refined cell parameters, $a = b = 6.2136$ Å, $c = 7.4141$ Å, are in good agreement with the literature data. Lattice parameter c is a measure of the interlayer distance, thus varies with water content. The value of the refined c parameter implies that the structure consists two water molecules per formula unit.

The working electrode is prepared from a slurry of sonochemically derived $VOPO_4 \cdot 2H_2O$ as an active material, carbon black, and a binder dispersed in a solvent. Two different binders are used: polyvinylidene fluoride (PVDF), 2.4 wt% solution in N-methyl-2-pyrrolidone or Nafion, 5 wt% solution in a mixture of lower aliphatic alcohols and water. Cyclic voltammetry measurements are done in several electrolytes to probe the intercalation of various cations such as magnesium, calcium, and aluminium. The best results are obtained when the electrode is cycled in 1M $Al(NO_3)_3$ aqueous solution.

This probably originates in different ionic radii.

During the process of electrode preparation, structural changes in the powder are noticed. The structural changes were followed step by step through the combined XRD and FTIR analysis. It turns out that the structure is prone to release water molecules even when the powder is mixed with carbon black and also with the addition of a solvent, which could lead to the formation of a bilayered vanadyl phosphate. It was shown that using different solvents has a diverse impact on the structure, and consequently on powders' cyclic performances (Figure 1).

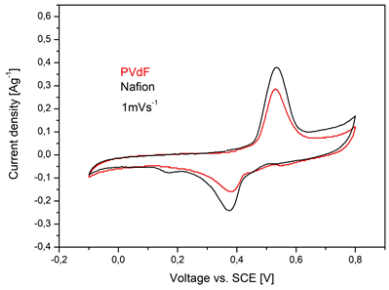

Figure 1. The cyclic voltammograms of $VOPO_4 \cdot 2H_2O$ electrodes prepared with two different binders, PVdF and Nafion.

References

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Dr Dragana Jugović is a Principal Research Fellow at the Institute of Technical Sciences of SASA.

Her scientific research activity is oriented toward the synthesis and physicochemical characterization of materials that find their application as electrode materials for lithium-ion batteries and other rechargeable batteries. She is especially interested in examining the relationship between the structural and transport properties of the synthesized materials.

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