SYNTHESIS OF POLYMER ELECTROLYTES IMPROVED BY THE ADDITION OF LINBO3 FOR RECHARGEABLE BATTERIES

VI Congresso Online Nacional de Química, 1ª edição, de 22/04/2024 a 24/04/2024
ISBN dos Anais: 978-65-5465-089-2
DOI: 10.54265/CQKD2800

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RESUMO

Química de Materiais (MAT) Introduction Lithium-ion rechargeable batteries (*LIBs*) components of numerous electronic devices and energy storage systems, have drawn significant attention from researchers because of their importance in improving efficiency and safety[1]. Among the vital components of lithium-ion batteries is the electrolyte, which facilitates the transportion of lithium ions between the positive and negative electrodes. This study, aims to develop an *SPE* that enhances the properties of *LIBs* by synthesing, materials composed of lithium perchlorate ($LiClO_4$), polyvinyl alcohol (PVA) and polyethylene oxide (PEO), with the addition of lithium niobate ($LiNbO_3$). The study revealed that incorporating $LiNbO_3$ on the polymeric matrix increased the ionic conductivity (σ) and lithium transfer number (t_+) of the electrolytes, which are critical factors for enhancing battery performance. **Objective** The main objective of the research is the development of polymeric solid electrolytes based on pure $LiClO_4$/PVA-PEO and improved by the insertion of $LiNbO_3$ to replace conventional liquid electrolytes for use in rechargeable lithium-ion batteries. **Methods** Originally, $LiNbO_3$ powders were synthesized in the laboratory from specific precursors (hydrated lithium oxalate, $Li_2C_2O_4 \cdot 2H_2O$, and niobium pentoxide, Nb_2O_5), calcined at 600°C. Subsequently, pure *SPE* (*A* = $LiClO_4$/PVA-PEO) and the *SPE* with the addition of $LiNbO_3$ (*B*) were synthesized. Using a digital caliper, the thickness was measured, and the area of the *SPE* was calculated. After a one-week curing time, the dried *SPE* was placed between two stainless steel plates (sandwich) of the same dimensions for electrochemical analyses. Electrochemical impedance spectroscopy (EIS) and chronoamperometry tests were performed using the AUTOLAB PGSTAT 128 N potentiostat, coupled with the NOVA® 2.0.1 software copyright 2016, Metrohm Autolab B.V. **Results** The structural analysis by X-ray diffraction (XRD) revealed the rhombohedral phase of $LiNbO_3$ (JCPDS Nº. 20-631). Scanning Electron Microscopy (SEM) images showed that the material had a porous structure with a uniform distribution of $LiNbO_3$ clusters. The EIS results showed that the ionic conductivity increased by approximately 16.17% after the addition of $LiNbO_3$ (*SPE/B*). Additionally, the EIS results combined with chronoamperometry allowed obtaining values for current densities and charge transport resistances at the beginning (i_0, R_{e0}) and at the end (i_{SS}, R_{eSS}). With the collected results, calculations were performed to obtain lithium transfer numbers (t_+, $0 \le t_+ \le 1$ → for *SPE*). The results showed that t_+ = 0.213 for *SPE/A* and t_+ = 0.839 for *SPE/B*. **Conclusion** The results confirmed the synthesis of an *SPE* that uses lithium salt, promoting an increase in ionic conductivity (σ = 1.02E-03 Ω cm^{-1}) and in the lithium transfer number (t_+ = 0.839) at 25ºC. This, demonstrates the potential of the developed *SPE*, especially after the insertion of $LiNbO_3$, and indicates that it is a simple, cost-effective, and promising strategy, for improving key components of rechargeable lithium ion batteries.

Acknowledgments The authors are grateful to FAPEMIG, CNPq, CAPES (code 001), and FINEP 01.22.0271.00 for financial support and scholarships.

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[1]Deivanayagam, R.; Shahbazian-Yassar, R. *Electrochemical methods and protocols for characterization of ceramic and polymer*

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electrolytes for rechargeable batteries. Batteryes & Supercaps. **2020**, *4, 596-606.*
(RESUMO COM APRESENTAÇÃO ORAL)

PALAVRAS-CHAVE: Ionic conductivity (σ), lithium perchlorate (LiClO4), lithium transfer number (t+), rechargeable LIBs, solid polymer electrolyte (SPE)

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