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

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NETO; Antero Ricardo Santos [1], SOUZA; Rafael R. de [2], SANTOS; Wayler S. dos Santos [3], RODRÍGUEZ; Mariandry Rodríguez [4], NOGUEIRA; Francisco G. E. [5], PEREIRA; Marcio C. Pereira [6]

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

[1] UFVJM, antero.ricardo@hotmail.com
[2] UFVJM, souza.rafael@ufvjm.edu.br
[3] UFVJM, wayler.silva.santos@ufvjm.edu.br
[4] UFVJM, mariandry.rodriguez.r@gmail.com
[5] UFSCar, nogueira@ufscar.br
[6] UFVJM, mcpqui@gmail.com

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_+, $0 \leq t_+ \leq 1 \rightarrow$ 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.

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

[1] UFVJM, antero.ricardo@hotmail.com
[2] UFVJM, souza.rafael@ufvjm.edu.br
[3] UFVJM, wayler.silva.santos@ufvjm.edu.br
[4] UFVJM, mariandry.rodriguez.r@gmail.com
[5] UFSCar, nogueira@ufscar.br
[6] UFVJM, mcpqui@gmail.com