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Physicochemical Properties of Ag-doped Li_3VO_4 as Anode Material for Mithium Ion Batteries

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ABSTRACT

In this work, Li_3VO_4 (LVO) and silver-doped Li_3VO_4 (LVO-Ag) samples have been synthesized via the solgel method and followed with calcinations for their uses as anode materials for lithium ion battery LIBs. The synthesized samples were characterized by XRD, SEM, and CV tests. XRD results showed that the Ag^+ doping into Li_3VO_4 can lead to lattice micro expansion which favors the intercalation and deintercalation of the Li ions. The SEM characterization displayed that LVO-Ag has a good morphology with a uniform and smaller particle size than that of LVO. The CV measurements demonstrate that Ag doped Li_3VO_4 samples exhibit enhanced electrochemical performance compared to undoped LVO. Therefore, the LVO-Ag sample could serve as a promising anode material for high performance LIBs.

Keywords: Anode material, Lithium-ion battery, Lithium vanadate, Silver doping, Physicochimiques properties.

1. Introduction

Lithium vanadate (Li_3VO_4) has been reported as a potential intercalation/deintercalation anode material for lithium ion batteries (LIBs) with a safe voltage plateau, higher theoretical specific capacity, easy synthesis process and low cost [1,2]. However, its lower electrical conductivity and low initial coulombic efficiency (ICE) limit its development and use in practical applications. To improve these aspects, many strategies have been proposed such as synthetic method [3], compositing [4], ion doping [5,6] and surface coating [7]. Elemental doping has been found to be an effectual approach to enhancing the properties of Li_3VO_4 (LVO) as an anode because ionic doping is the only method that can directly improve electronic conductivity within the LVO crystal. In this study, we report the improved electrochemical performance of LVO by doping with Ag. The Ag-doped Li_3VO_4 (LVO-Ag) sample has been synthesized via the sol-gel method and heating-treatment procedures. The as-prepared samples were investigated by XRD and SEM characterizations. The electrochemical performance of Ag-doped Li_3VO_4 as anodes for LIBs was studied by CV measurement.

2. Experimental

Li_3VO_4 is fabricated by a sol gel method and heating-treatment procedures using ammonium metavanadate (NH_4VO_3) as the precursor materials, lithium carbonate (Li_2CO_3) as a source of lithium, citric acid as a chelating agent and silver nitrate($AgNO_3$) as a source of silver.

3. Results and Discussion

The XRD results indicated that the Ag^+ ion has been successfully incorporated into the lattice of Li_3VO_4, which caused an expansion of the lattice and decrease in the size of the crystallites which favors the intercalation and the deintercalation of the Li ions. In addition, SEM characterization displayed that LVO-Ag has a good morphology with a uniform and smaller particle size than that of LVO. The evaluation of the electrochemical properties of the LVO-Ag sample by cyclic voltammetry exhibits good storage performance for lithium ions.

4. Conclusions

Li_3VO_4 and silver-doped Li_3VO_4 have been successfully synthesized via the sol-gel way followed by

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calcination. Structural and morphological analysis shows that Ag doping results in a slight lattice expansion and good morphology with a uniform and smaller particle size that favors the intercalation and deintercalation of Li ions. CV results confirm that the Ag doping enhanced the electrochemical properties of Li_3VO_4. Thus, Ag-doped Li_3VO_4 could be a promising anode material for high performance LIBs owing to their excellent physicochemical properties.

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