

Effect of different calcination temperatures on the electrochemical properties of ZnV_2O_4 as an anode material for Na-ion batteries

Irish Valerie B. Maggay and Wei-Ren Liu

Department of Chemical Engineering, Chung Yuan Christian University, Chungli District, Taoyuan City, 32023, Taiwan

E-mail: irish.maggay@gmail.com

Due to the excessive costs and geographical limitations of lithium resources, alternative alkali-ion based batteries are being explored [1]. One of the most viable alternative is the Sodium-ion battery (SIB) due to its low cost, abundance and availability [2]. To date, the most common anode material for SIB is hard carbon, however, it suffers from large volume change during sodiation and de-sodiation. Conversion anode materials have been greatly regarded due to their high theoretical capacity and numerous phases [3], but their reaction with the Na^+ has not been fully understood. In this study, ZnV_2O_4 was synthesized through simple solvothermal method with post-heat treatment under H_2/N_2 for 4 hours to ensure the formation of spinel structure. The influence of the different calcination temperatures (500-700°C) on the electrochemical performance were thoroughly investigated. In the cyclic tests, initial irreversible discharge capacities of ~ 150 , ~ 100 , and $\sim 65^\circ \text{mAh}\cdot\text{g}^{-1}$ were obtained for 500, 600, and 700°C, respectively. The difference in electrochemical properties could be ascribed to the difference in morphologies which is highly influenced by the calcination temperature. Further characterizations will be employed to get a better understanding of the Na^+ ion diffusion and electron transport, and conversion reactions of metals using impedance spectroscopy, cyclic voltammetry and ex-situ XRD analyses.

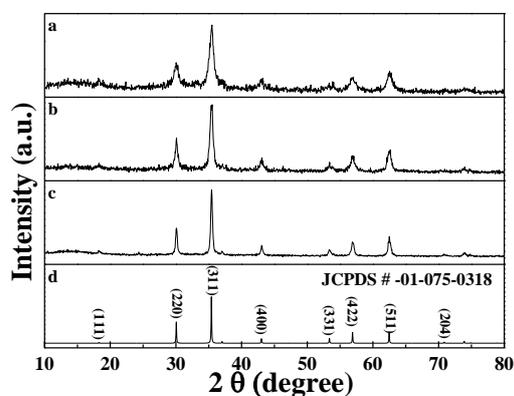


Figure 1. XRD profiles of ZnV_2O_4 calcined at (a) 500°C, (b) 600°C, (c) 700°C and (d) standard pattern.

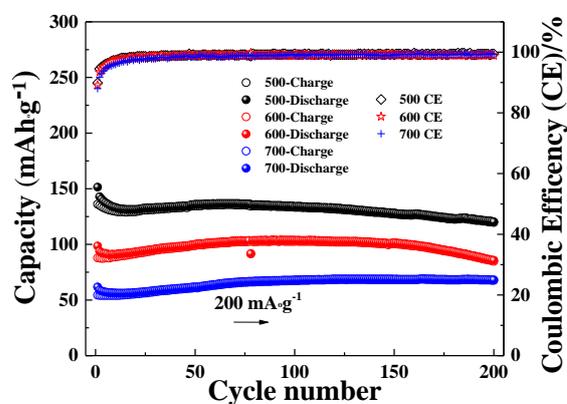


Figure 2. Cycle life tests of ZnV_2O_4 calcined at different temperatures.

References:

- [1] B. Qu, C. Ma, G. Ji, C. Xu, J. Xu, Y.S. Meng, T. Wang, J.Y. Lee, *Adv. Mater.* 26 (2014) 3854-3859.
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- [3] Y. Liu, N. Zhang, C. Yu, L. Jiao, J. Chen, *Nano Lett.* 16 (2016) 3321-3328.