$LiVOPO_4$ as a negative electrode material for rechargeable lithium batteries

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Nowadays, demands lithium ion batteries which are mounted in a portable devices increase day by day. As a result, research towards positive and negative electrode materials being intensively progressed.

Graphite is one of the most commonly used negative materials because it has reasonable rechargeable capacities and good cyclability. However, negative material needs more capacity than graphite to further capacity of rechargeable lithium batteries. Hence metal oxide materials are focused as alternative negative electrode owing to their large capacity. Among them, olivine structure $LiMPO_4$ (M = Fe, Mn, Co, Ni, etc.) are considered as possible candidate materials because of their structured and thermal stabilities. In this paper physical and electrochemical properties of $LiVOPO_4$, which has orthorhombic structure (*Pnma* space group), is investigated.

Olivine structured $LiVOPO_4$ is synthesized by emulsion drying method. Stoichiometric amount of $LiNO_3$, $NH_4H_2PO_4$, and V_2O_5 were dissolved in distilled water. In the starting emulsion the atomic ratio of Li : V : PO_4 was 1 : 1 : 1. The aqueous solution was then vigorously mixed with a mixture of an oily phase, Kerosene : Tween 85 = 6 : 4 in volume, to prepare a homogeneous water-in-oil(W / O) type emulsion, in which cations are distributed very uniformly on an atomic scale. Finally, the prepared W/O type emulsion containing $LiNO_3$, $NH_4H_2PO_4$, and V_2O_5 is mainly composed of an oil phase (aqueous : oil phase = 1.5 : 8.5 in volume). Precipitates were filtered to remove residual kerosene and then calcine at 750 ^oC for 2 h in air atmosphere. The synthesized $LiVOPO_4$ powders were identified by X-ray diffraction (XRD) with Cu Kα radiation and analyzed by Rietveld refinement. Electrochemical test were carried out in coin type cell. Galvanostatic electrochemical charge and discharge test were made between 0 V and 3.0 V at 100 mAg^{-1} current at room temperature.

The XRD pattern of the product shows single phase $LiVOPO_4$ with *Pnma* space group. The galvanostatic charge/discharge performances of $LiVOPO_4$ as an negative electrode are tested in voltage range of 0 V and 3.0 V. As an negative electrode, the sample shows high initial charge capacity is 667 $mAhg^{-1}$. The charge capacity for 50 cycles is 459 $mAhg^{-1}$, and the charge capacity retention rate is 68.8 %. Also, C-rate property is measured with battery cycler. The $LiVOPO_4$ shows good C-rate performance, delivering capacities 344.7 $mAhg^{-1}$ at 10 C in the voltage range of 0 V and 3.0 V. Details will be discussed in the conference site.