Synthesis of Fine Particles of $LiFePO_4$ Cathode Material for Lithium ion Battery using a Hydrothermal Method

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Iron is expected as a positive electrode material because of its large Clarke number. In this reason, we have been interesting in materials with iron and been studying. $Fe_2(SO_4)_3$ is the most interesting materials because of the highest voltage, 3.7V, v.s. Li/Li+ in materials with iron. However, cycle performance is quite poor. And then, we studied method to improve cycle performance of $Fe_2(SO_4)_3$ and reported[1]. We succeeded to make $Fe_2(SO_4)_3$ exhibits good cycle performance. But useful capacity was become about 65mAh/g(theoretical capacity:130Ah/g), the value is very little for use as a Lithium iron battery.

Then, we looked for other material with iron and focused $LiFePO_4$. It shows a high voltage discharge curve, 3.4V v.s. Li/Li^+. 3.4V discharge region shows extremely flat. Theoretical capacity of $LiFePO_4$ is, 170mAh/g, sufficient to be used as Lithium ion battery ($LiCoO_2$: 274mAh/g, $LiMn_2O_4$: 148mAh/g). However reported[2)3)] discharge capacity of $LiFePO_4$ is not so good(115mAh/g, 0.5mA/cm^2) .

In this study, we have tried to obtain good cycle performance and improve discharge capacity of $LiFePO_4$ by making fine particle of $LiFePO_4$ using hydrothermal method. In addition, we used Polyethylene Glycol to a starting solution. Furthermore we added Polyvinyl Alcohol to the sample to improve the electric conductivity. As the result, we improved below 3points.

1. Succeeded in improving Discharge capacity.
   5th Discharge capacity = 130mAh/g(0.5mA/cm^2)
2. Succeeded in improving Cycle performance.
   10th Discharge capacity =132mAh/g(keep 100% v.s. 5th discharge capacity)
3. Succeeded in discharge with large current
   Discharge were conducted over 3mA/cm^2(80mAh/g)

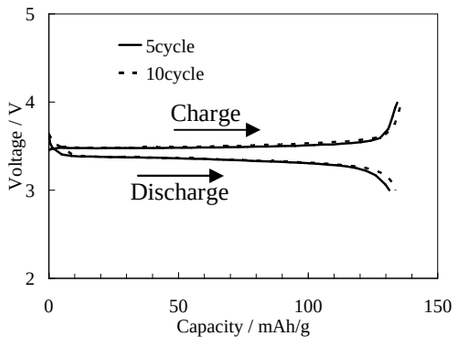

Fig.1 Charge / Discharge curves of $LiFePO_4$ with carbon coating at 0.5mAh/g.

1) H. Okawa, M Sato, Proc. of 2000 Int. Chemical Congress of Pacific Basin Societies(Honolulu, USA) No.06-27(1-3) (2000)
2) Masaya Takahashi, et al. J.Power Sources., 97, 508 (2001)
3) S. Yang, et al. Electrochem com., 3, 505(2001)