

## SYNTHESIS OF LITHIUM VANADATE AND ITS CHARACTERISATION

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[Received: 1 June 1998 Accepted: 22 June 1998]

In view of high specific capacity, possibility of lithium uptake to 3.0 Li/mol with respect to cycleability, structural stability, high rate capability (due to high diffusion of lithium) and deep dischargeability below 1.6 V lithium vanadate is preferred to  $V_6O_{13}$  in lithium secondary cells. To have materials of less particle size, sol-gel synthesis coupled with proper dehydration processes are followed to synthesize  $LiV_3O_8$  and it is characterized by XRD and FTIR analysis. Results are presented in this communication.

Keywords: Lithium vanadate, sol-gel synthesis, structural stability.

## INTRODUCTION

Much effort has been made in 80's to develop suitable cathode material for secondary lithium cells.  $TiS_2$  and  $V_6O_{13}$  have been employed extensively [1].  $TiS_2$  had indeed impressive features in terms of reversibility and rate capability [2-3]. However, reduced energy density and instability in moist air were the main drawbacks, which limited its application in practical cells.  $V_6O_{13}$  was thought of substituting  $TiS_2$  in lithium cells and had been tried as positive electrode [4,5]. This material has greater energy density than  $TiS_2$  and strict stoichiometry need not be mentioned for optimum performance.

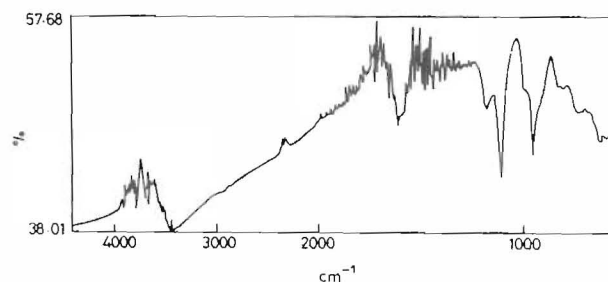
Their cycling behaviour at current densities around  $1 \text{ mA/cm}^2$  is characterized by high and stable specific capacities after the first few cycles [6] that is 0.16-0.20 Ah/g. However, an important drawback is reported for both  $V_6O_{13}$  (stoichiometric) and especially  $V_6O_{13}$  (non-stoichiometric). At 1.6 V, a reduction process occurs which inhibited further rechargeability [6]. This is probably due to structural instability in the reorganizations connected with the high Li content (2.37  $Li^+/V$ ). This drawback was the main reason to discourage the use of these materials in practical lithium cells. An attempt was made to overcome this drawback by using a material which, while retaining the basic electrochemical features of  $V_6O_{13}$ , would be able to undergo overdischarges without structural damage. The

$Li_{1+x}V_3O_8$  phase investigated in [7] is closely related in structure to  $V_6O_{13}$ .

This bronze, a layered compound whose layers are held together by  $Li^+$  ions [7] has proven to be able to insert lithium in its structure with outstanding energy, power and cycling capability. This bronze is superior to  $V_6O_{13}$  in such aspects as energy density, rate capability, cycle life and resistance to overdischarge. On this basis this ternary oxide did seem worthy of a further investigation. Early in the development it was realized [8] that the methods used to prepare oxide strongly influenced its electrochemical properties. It was demonstrated that [8]  $LiV_3O_8$  prepared in an amorphous glassy state by rapid quenching from the melt had a higher initial capacity than the crystalline analogue. These findings were, however, not pursued further even though several research groups reported on the use of crystalline  $LiV_3O_8$  as host material for lithium intercalation [9- 18].

Several preparation procedures have been devised to improve the performance of  $LiV_3O_8$  including control of stoichiometry by rapid cooling [18], more efficient grinding [19] and addition of inert nucleation centres like silica or alumina to the melt [20]. The main problem in all these seems to be that on slow cooling,  $LiV_3O_8$  crystallized as a very hard and tough material, which is difficult to process into proper electrode structures that can maintain their integrity during deep cycling. It is recently reported that [21] fully amorphous  $LiV_3O_8$  obtained from a precipitation technique showed significantly higher capacity, better rate



Fig.4: FTIR spectra of  $\text{LiV}_3\text{O}_8$ 

### CONCLUSION

Lithium vanadate has been prepared by sol-gel method as this material is preferred to  $\text{V}_6\text{O}_{13}$  in lithium secondary cells due to its high cycleability, structural stability high rate capacity and deep dischargeability below 1.6 V. The material prepared by sol-gel has been characterized.

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