Effect of Polymer Binders on the Electrochemical Performance of Al-doped Lithium Titanate Electrode

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Abstract: The investigation of polymers as binders of Al doped $Li_4Ti_5O_{12}$ for Li-ion battery electrode is reported. Polimer binders such as Polyvinylidene fluoride (PVDF), polyvinyl alcohol (PVA), and Polytetrafluoroethylene (PTFE) were used to make electrode sheet. Al doped Lithium Titanate (Al-doped $Li_4Ti_5O_{12}$) were used as electrode powders. Al doped $Li_4Ti_5O_{12}$ powders were synthesized from $LiOH.H_2O$, TiO_2 and Al_2O_3 via solid state reaction. X-ray diffraction (XRD) was used to analysed phase and size of particle. Electrode sheets were manufactured by used active material, binders, and acetylene black in ratio 85:10:5 wt%. Electrode sheets were cut and assembled into coin cell batteries. Coin cell samples were characterized by EIS, cyclic voltammetry and charge-discharge to get electrochemical performance. XRD result reveals that there are two phases formed from final product such as $Li_4Ti_5O_{12}$ and rutile TiO_2. EIS diagram showed that sample with PTFE binder has the best conductivity with 3.10^{-5} S/cm. While, cyclic voltammetry and charge-discharge test showed sample with PVDF binder has the best chemical performance with good redox peaks and highest specific capacity about 110 mAh/g.

Keywords: Al doped $Li_4Ti_5O_{12}$, Batteries, Polyvinylidene fluoride (PVDF), polyvinyl alcohol (PVA), Polytetrafluoroethylene (PTFE)

References:

[1] J. M. Tarascon., Key challenges in future Li-battery research, Phil. Trans. R. Soc. A (2010) 368, 3227-3241
[2] N. Nitta., F. Wu., J. T. Lee., G. Yushin., Li-ion battery materials: present and future., Materials Today (2015) 18, 252-264
[3] M. Armand., J. M. Tarascon., Building better batteries, Nature. (2008) 451, 652-657
[4] X. C. Sun., P. V. Radovanovic., B. Cui., Advances in spinel Li4Ti5O12 anode materials for lithium-ion batteries., New J. Chem (2015) 39, 38-63
[5] J. Liu., Y. Shen., L. Chen., Y. Wang., Y. Xia., Carbon coated Li4Ti5O12 nanowire with high electrochemical performance under elevated temperature., Electrochimica Acta 156 (2015) 38-44
[6] S. Priyono., J. Triwibowo., B. Prihandoko., The effect of 0.025 Al-doped in Li4Ti5O12 material on the performance of a. half-cell lithium ion battery., AIP conference proceedings 1711, 060001 (2016)
[7] W. Liu., X. Huang., G. Li., Z. Wang., H. Huang., Z. Lu., R. Xue., L. Chen., J. Power Sources 68 (1997) 344
[8] Z.Wang, N. Dupr´e, A.-C. Gaillot, B. Lestriez, J.-F. Martin, L. Daniel, S. Patoux, and D. Guyomard, Electrochim. Acta, **62**, 77 (2012).
[9] N. Cuesta., A. Ramos., I. Camean., C. Antuna., A. B. Garcia., Hydrocolloids as binders for graphite anodes of lithium-ion batteries., Electrochimica Acta 155 (2015) 140-147

[10] A. Magasinski., B. Zdyrko., I. Kovalenko., B. Hertzberg., R. Burtovyy., C. F. Huebner., T. F. Fuller., I. Luzinov., G. Yushin., Toward Efficient Binder for Li-Ion Battery Si-Based Anodes: Polyacrylic Acid., ACS Appl. Mater. Interfaces, 2010 2 (11), pp 3004-3010