Sintesis serbuk Li4Ti5O12 yang didoping atom Al dan Na untuk material anoda pada baterai ion lithium = Synthesis of Li4Ti5O12 powder doped by al and na atoms for lithium ion battery anodes

Slamet Priyono, author

Abstrak

[ABSTRAK
Sintesis serbuk Li4Ti5O12 yang didoping atom Al dan Na untuk material anoda pada baterai ion lithium telah berhasil dilakukan dengan metode reaksi padat. Doping Al pada Li4Ti5O12 bertujuan untuk menaikkan konduktifitas ionik dan memperkuat struktur sedangkan doping Na bertujuan untuk menurunkan tegangan operasi. Pendopingan dilakukan dengan mengikuti persamaan Li(4-(x/3+y))AlxNayTi(5-2x/3)O12 (x=0; 0,025; 0,05; 0.075 dan y= 0;1) dimana atom Al mensubtitusi Ti dan Li sedangkan atom Na mensubtitusi Li. Sintesis dilakukan melalui metoda metalurgi serbuk dengan menggunakan Li2CO3, TiO2-anatase, Al2O3 and Na2CO3 sebagai bahan baku. Pada penelitian ini, pengaruh subtitusi Na dan Al dalam Li4Ti5O12 terhadap struktur, morphologi, ukuran partikel, surface area dan performa elektrokimia diteliti secara detil. Hasil penelitian menunjukkan bahwa doping ion Al pada Li4Ti5O12 tidak merubah struktur kristal Li4Ti5O12. Hasil FTIR menkonfirmasi tidak adanya perubahan struktur spinel pada gugus khas ketika didoping Al, dengan meningkatnya doping Al membuat tekstur butir menjadi berpori, ukuran partikel menurun dengan ukuran terkecil 20,32 m, surface area meningkat dengan nilai tertinggi 8,25 m2/gr, konduktifitas ionik meningkat dengan konduktifitas terbaik adalah 8,5 x 10-5 S/cm, tegangan kerja sekitar 1,55 V dan kestabilan siklus terbaik diperoleh pada doping Al 0,025 dengan kapasitas maksimum 70 mAh/g,. Sedangkan doping Na dalam Li4Ti5O12 menyebabkan perubahan struktur dengan terbentuk 3 phasa baru yaitu NaLiTi3O7, Li4Ti5O12, dan Li2TiO3. Perubahan struktur juga dikonfirmasi dengan perubahan gugus khas hasil analysis FTIR. Sedangkan kenaikan doping Al menyebabkan phasa NaLiTi3O7 semakin dominan, tekstur butiran menjadi halus, ukuran partikel menurun dengan ukuran terkecil 30,89 m, surface area menurun, konduktifitas ionic stabil pada 2,5 x 10-5 S/cm, potensial kerja di 1,3 V dan 1,55V, kestabilan struktur didapat pada doping Al 0,05 dengan kapasitas 90 mAh/g. Secara keseluruhan menunjukkan bahwa penambahan doping Al mampu meningkatkan konduktifitas ionik dan kestabilan siklus dan doping Na menurunkan tegangan kerja.
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ABSTRACT
Synthesis of Li4Ti5O12 powder doped by Al and Na atoms for lithium ion battery anodes had been carried out using solid state reaction. Al doped on Li4Ti5O12 aim

is to increase the ionic conductivity and strengthen the structure of Li4Ti5O12 while Na doped aimed is to decrease the operating voltage. Al and Na doped on Li4Ti5O12 had been carried out by following equation Li(4 - (x / 3 + y))AlxNayTi(5-2x/3)O12 (x = 0; 0,025; 0.05, 0.075 and y = 0, 1) where the Al atoms substitute Ti and Li while Na substituting Li atoms. Synthesis is conducted through a solid state reaction by using Li2CO3, TiO2-anatase, Al2O3 and Na2CO3 as raw materials. In this study, the effects of substitution of Na and Al in Li4Ti5O12 on the structure, morphology, particle size, surface area, and electrochemical performance were deep studied. The results showed that the Al doped on the Li4Ti5O12 was not change crystal structure of Li4Ti5O12. FTIR results confirmed that the absence of changes spinel structure in fingerprint region when doped Al, with increasing Al doped make textures porous grains, particle size decreases to 20.32 m, surface area increases with highest value of 8.25 m2/gr, conductivity is increased with the best conductivity 8.5 x 10-5 S/cm, , the working voltage of about 1.55 V and the best cycle stability was obtained on doping Al 0.05 and the maximum capacity is 70 mAh/g. While doping Na in Li4Ti5O12 caused structural changes to the three phases formed NaLiTi3O7, Li4Ti5O12, and Li2TiO3. Tranformation on the structure is also confirmed by the changes in the fingerprint region with FTIR analysis. While the increase in Al doping causes NaLiTi3O7 phase become dominant, texture of granular becomes bigger and smoother, the particle size decreases to 30.89 m, surface area decreases, the ionic conductivity was stable at 2.5 x 10-5 S/cm, The working potential in 1, 3 V and 1.55 V, the stability of the structure obtained on doping Al 0.05 and the maximum capacity of 90 mAh/g. Overall showed that the addition of Al doped can improve the ionic conductivity while stability of the cycle and the Na doped decrease the working voltage;Synthesis of Li4Ti5O12 powder doped by Al and Na atoms for lithium ion battery
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