

# Pengaruh penambahan nano tembaga dan tabung nano karbon terhadap performa katoda LiFePO<sub>4</sub> pada baterai lithium ion = Effect of nano copper and carbon nano tube addition on cathode LiFePO<sub>4</sub> performance for lithium ion battery / Ratna Permata Sari

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## Abstrak

[Telah dilakukan peningkatan konduktivitas listrik LiFePO<sub>4</sub> dengan metode penambahan material logam nano Cu dan CNTs. Metode ini menjadi pilihan yang menarik karena mudah dan murah dalam proses pembuatannya. Proses sintesis dilakukan dengan mencampur serbuk LiFePO<sub>4</sub> (komersil) dengan variasi presentase berat nano tembaga (komersil) 0, 1, 3, 5, 7 wt. % dan 5 wt. % nano karbon (komersil) kemudian di proses vacuum mixing dan film applicator. Pengujian XRD, SEM dan EDX dilakukan pada serbuk yang diterima untuk mengkonfirmasi fasa, ukuran butir serta ada tidaknya impurities. Hasil XRD dan EDX pada serbuk nano Cu menunjukkan bahwa telah terjadi oksidasi dan terbentuk menjadi CuO dan Cu<sub>2</sub>O, serta ditemukan

adanya impurities elemen S sebesar 8.5 wt. %. Komposisi fasa yang dihasilkan dari proses penambahan didapat dari menganalisis pola difraksi XRD menunjukkan bahwa fasa yang terbentuk adalah LiFePO<sub>4</sub> namun ditemukan adanya impurities berupa Cu<sub>4</sub>O<sub>3</sub> pada variasi penambahan 80 wt. % LiFePO<sub>4</sub>, 5 wt. % Cu, 5 wt. % C, dan 10 wt. % PVDF. Konduktivitas listrik diuji material katoda LiFePO<sub>4</sub> dengan EIS, dan hasil uji menunjukkan bahwa konduktivitas listrik LiFePO<sub>4</sub> meningkat seiring dengan penambahan nano Cu namun tidak terlalu signifikan (dalam satu orde), hal ini dikarenakan efek oksidasi pada Cu.

Pada variasi penambahan nano C dan nano Cu terjadi peningkatan sebesar 3 orde dengan nilai konduktivitas sebesar  $8.4 \times 10^{-5}$  S/cm pada variasi penambahan 80 wt. % LiFePO<sub>4</sub>, 5 wt. % Cu, 5 wt. % C. Penambahan nano karbon pada LiFePO<sub>4</sub> lebih efektif dalam peningkatan konduktivitas dibandingkan dengan penambahan nano Cu

dikarenakan efek oksidasi pada Cu yang tidak dapat dihindari. Morfologi material katoda dan distribusi nano Cu dan nano karbon dianalisis menggunakan SEM/EDX, menunjukkan material yang dicampur pada variasi penambahan nano Cu cukup homogen, struktur butir spherical, sedangkan pada variasi penambahan nano Cu dan

nano karbon struktur butir polyhedral dengan ukuran butir berada pada rentang 100- 500 nm. Struktur butir ini mempengaruhi hasil cole plot dimana pada variasi penambahan Cu terbentuk semicircle sedangkan pada penambahan nano C tidak; Improved of Electrical conductivity of LiFePO<sub>4</sub> with the method of adding Cu

Nano metal material and CNTs has been done. This method is an attractive option because it is easy and inexpensive in the manufacturing process. Synthesis process is

done by mixing the powder LiFePO<sub>4</sub> (commercial) with a variation of the percentage by weight of Nano copper (commercial) 0, 1, 3, 5, 7 wt. % and 5 wt. % CNTs (commercial) and then process in vacuum mixing and film applicator. Testing XRD, SEM and EDX performed on the powder to confirm the phase, grain size and the presence or absence of impurities. Results of XRD and EDX on Nano Cu powder showed that there had been oxidation and formed into CuO and Cu<sub>2</sub>O, and discovered the existence of impurities elements S

of 8.5 wt. %.

Phase composition as the result from adding process obtained with analyzing the XRD diffraction pattern showed that the phase formed is LiFePO<sub>4</sub> yet found any impurities in the form of Cu<sub>4</sub>O<sub>3</sub> on variations LiFePO<sub>4</sub> addition of 80 wt. %, 5 wt. % Cu, 5 wt. % C, and 10 wt. % PVDF. The electrical conductivity of LiFePO<sub>4</sub> cathode material was tested by EIS, and the results showed that the electrical conductivity of LiFePO<sub>4</sub> increased with the addition of Nano-Cu but not too significant (still on the same order), this is because the effects of oxidation on Cu. On the addition of Nano C and Nano Cu variation there is an increase of 3 order with conductivity value  $8.4 \times 10^{-5}$  S / cm at variations LiFePO<sub>4</sub> addition of 80 wt.%, 5 wt.% Cu, 5 wt.% C. The addition of CNTs is more effective in LiFePO<sub>4</sub> conductivity increase, compared to the addition

of Nano-Cu due to the effects of oxidation on Cu are unavoidable. Cathode material morphology and distribution of CNTs and Nano Cu analyzed using SEM / EDX, showed mixed material on the variation of the addition of Nano Cu quite homogenous, spherical grain structure, while the variation of the addition of Nano Cu and CNTs structures polyhedral grains with a grain size in the range 100-500 nm. This affects the grain structure results in a variation of Cole plot where the addition of Cu is formed semicircle, while the addition of Nano C is not.;Improved of Electrical conductivity of LiFePO<sub>4</sub> with the method of adding Cu Nano metal material and CNTs has been done. This method is an attractive option because it is easy and inexpensive in the manufacturing process. Synthesis process is done by mixing the powder LiFePO<sub>4</sub> (commercial) with a variation of the percentage by weight of Nano copper (commercial) 0, 1, 3, 5, 7 wt. % and 5 wt. % CNTs (commercial) and then process in vacuum mixing and film applicator. Testing XRD, SEM and EDX performed on the powder to confirm the phase, grain size and the presence or absence of impurities. Results of XRD and EDX on Nano Cu powder showed that there had been oxidation and formed into CuO and Cu<sub>2</sub>O, and discovered the existence of impurities elements S of 8.5 wt. %.

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