INTISARI

Kelimpahan akan lignin yang banyak tersedia di alam belum dimanfaatkan secara maksimal. Salah satu sumber lignin berasal dari pohon kelapa sawit. Lignin tersebut dapat menjadi salah satu bahan baku untuk pembuatan material elektroda superkapasitor berbasis karbon. Pada penelitian ini material elektroda superkapasitor disintesis dari lignin dengan menggunakan metode *templating* dan penambahan mangan oksida, sehingga dapat meningkatkan kemampuan performa elektrokimia material berbasis karbon.

Tahapan penelitian ini meliputi ekstraksi lignin menggunakan metode organosolve, sintesis material karbon dengan surfaktan dan penambahan oksida mangan, karbonisasi material sintesis, oksidasi permukaan material, karakterisasi material dan uji performa elektrokimianya. Karakterisasi material dilakukan dengan *Fourier Transform Infra Red* (FTIR) untuk mengetahui gugus fungsional, *Scanning Electrone Microscopy-Energy Dispersive X-Ray* (SEM-EDX) untuk mengamati morfologi partikel material dan dispersi elemen, *X-Ray Diffraction* (XRD) untuk mengetahui fasa kristal oksida mangan, analisis *N_2-sorption* untuk mengetahui struktur pori dan luas permukaan serta *Thermogravimetric Analysis* (TGA) untuk studi kinetika proses karbonisasi material. Uji performa material elektroda superkapasitor menggunakan metode *three electrode system* dengan larutan elektrolit H_2SO_4 1 M.

Hasil karakterisasi menunjukkan terbentuknya struktur mesopori yang semakin meningkat dengan penambahan surfaktan serta oksida mangan. Luas permukaan tertinggi didapatkan dari penambahan surfaktan sebesar 120%wt dari lignin sebesar 1425 m^2/gr dan ukuran pori rerata 3,14 nm pada penambahan oksida mangan didapatkan ukuran pori terbesar berkisar 5,23 nm dengan luas permukaan sebesar 922 m^2/gr. Hasil uji elektrokimia terbaik didapatkan dari material yang disintesis dengan surfaktan untuk proses templating sebesar 120% dan penambahan oksida mangan sebesar 20%wt dari lignin serta dioksidasi dengan H_2O_2 (LS120%-Mn20%-ox). Kapasitansi spesifik yang didapatkan material LS120%-Mn20%-ox sebesar 345 F/gr dengan *energy density* sebesar 139 Wh/kg dan *power density* sebesar 776 W/kg pada *scanrate* 50mV/s.

ABSTRACT

The abundance of lignin that is widely available in nature has not been fully utilized. One of the sources of lignin comes from oil palm trees. The lignin can be one of the raw materials for the manufacture of carbon-based supercapacitors. In this study, the carbon-based supercapacitor material was modified by synthesizing it using the templating method and adding manganese oxide, so as to improve the electrochemical performance of carbon-based materials.

The stages of this research include lignin extraction using the organosolve method, synthesis of carbon material with surfactants and addition of manganese oxide, carbonization of the synthetic material, oxidation of the surface of the material, characterization of the material and test of its electrochemical performance. Material characterization was carried out by *Fourier Transform Infra Red* (FTIR) to determine functional groups, *Scanning Electrone Microscopy-Energy Dispersive X-Ray* (SEM-EDX)to observe material particle morphology and element dispersion, *X-Ray Diffraction* (XRD) to determine the crystalline phase of manganese oxide, *N_2-sorption* analysis to determine pore structure and surface area and *Thermogravimetric Analysis* (TGA) to study the kinetics of the carbonization process. material. Test the performance of the supercapacitor electrode material using the three electrodes system method with a 1 M H_2SO_4 electrolyte solution.

The characterization results showed the formation of mesoporous structures which increased with the addition of surfactants and manganese oxide. The highest surface area was obtained from the addition of a surfactant of 120% wt of lignin of 1425 m^2/g and a mean pore size of 3.14 nm, the addition of manganese oxide obtained the largest pore size of around 5.23 nm with a surface area of 922 m^2/gr. The best electrochemical test results were obtained from materials synthesized with surfactants for the templating process by 120% and the addition of manganese oxide by 20% wt from lignin and oxidized with H_2O_2 (LS120%-Mn20%-ox). The specific capacitance obtained by the LS120% -Mn20% -ox material is 345 F / gr with an energy density of 139 Wh/kg and a power density of 776 W/kg at a scan rate of 50mV/s.