BAB V

KESIMPULAN DAN SARAN

5.1 Kesimpulan

Berdasarkan hasil penelitian mengenai karakterisasi karbon tempurung kelapa sebagai material elektroda superkapasitor menggunakan metode *Scanning Electron Microscope* (SEM) dan *Brunauer–Emmett–Teller* (BET), dapat disimpulkan bahwa:

1. Karakteristik morfologi karbon tempurung kelapa tanpa aktivasi kimia pada suhu 900°C menunjukan struktur yang berlapis, permukaan kasar, berongga dengan luas permukaan spesifik (BET) mencapai 384,39 m^2/g.
2. Karakteristik morfologi karbon dengan aktivasi kimia KOH 20% pada suhu 900°C menghasilkan struktur berpori ireguler, namun mengalami indikasi kerusakan pori (over activation), sehingga luas permukaan spesifiknya menyusut menjadi 336,38 m^2/g.
3. Karakteristik morfologi mempengaruhi potensi kinerja karbon sebagai elektroda superkapasitor. Karbon tanpa aktivasi di suhu 900°C memiliki keunggulan area aktif penyimpanan muatan (EDLC) yang lebih besar dan stabil dibandingkan karbon yang diaktivasi kimia di suhu yang sama.

5.2 Saran

Berdasarkan hasil penelitian yang telah dilakukan, beberapa saran untuk penelitian selanjutnya adalah sebagai berikut:

1. Melakukan variasi suhu karbonisasi dan suhu aktivasi untuk memperoleh kondisi optimum dalam menghasilkan karbon dengan luas permukaan dan struktur pori yang lebih baik.
2. Melakukan variasi rasio impregnasi KOH terhadap karbon dan waktu aktivasi agar proses pembentukan pori berlangsung lebih optimal tanpa menyebabkan kerusakan struktur karbon.
3. Melakukan karakterisasi yang lebih lengkap, seperti analisis distribusi ukuran pori dan volume pori, sehingga hubungan antara morfologi karbon dan luas permukaan dapat dianalisis secara lebih komprehensif.

4. Melakukan pengujian elektrokimia, seperti *Cyclic Voltammetry* (CV), *Galvanostatic Charge–Discharge* (GCD), dan *Electrochemical Impedance Spectroscopy* (EIS) untuk mengetahui kapasitansi spesifik, rapat energi, rapat daya, efisiensi coulombic, serta stabilitas siklus karbon aktif sebagai elektroda superkapasitor.
5. Mengkaji penggunaan bahan aktivator lain, seperti asam fosfat (H_3PO_4), seng klorida ($ZnCl_2$), atau natrium hidroksida (NaOH), sehingga dapat dibandingkan efektivitas masing-masing aktivator dalam meningkatkan karakteristik karbon aktif berbasis tempurung kelapa.
6. Melakukan optimasi proses pencucian setelah aktivasi agar sisa senyawa KOH dapat dihilangkan secara optimal (hingga mencapai pH netral), sehingga tidak memengaruhi karakteristik permukaan karbon dan performa elektrokimianya.

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