BAB V
KESIMPULAN DAN SARAN

5.1 Kesimpulan

Dari penelitian ini, dapat disimpulkan beberapa kesimpulan antara lain sebagai berikut:

1. Penambahan doping nitrogen pada bahan baku menyebabkan terjadinya penurunan *yield hydrochar*. *Yield* HC-0 sebesar 47,26%, *yield* HC-1 sebesar 42,85%, *yield* HC-3 sebesar 41,93%, dan *yield* HC-5 sebesar 35,13%.
2. Penambahan doping nitrogen pada bahan baku juga menyebabkan terjadinya penurunan *yield* karbon aktif dimana besaran *yield* AC-N-1-B sebesar 22,50%, *yield* AC-N-3-B sebesar 19,88%, dan *yield* AC-N-5-B sebesar 17,21%. Namun, penambahan doping nitrogen saat aktivasi meningkatkan *yield* karbon aktif, dimana besaran *yield* AC-N-1-A sebesar 13,82%, *yield* AC-N-3-A sebesar 19,76%, dan *yield* AC-N-5-A sebesar 28,59%.
3. Penambahan doping pada karbon aktif memberikan peningkatan luas permukaan, dimana luas permukaan karbon aktif tanpa doping adalah sebesar 1165,13 m^2/g sedangkan untuk sampel dengan doping nitrogen terbesar adalah pada sampel AC-N-3-B dengan luas permukaan sebesar 1724,36 m^2/g.
4. Terbentuk gugus N-H dan C-N pada variasi *hydrochar* HC-3, dimana sampel tersebut diberikan doping nitrogen pada saat proses karbonisasi hidrotermal dan terbentuk gugus N-H, C-N, dan C=C=N pada karbon aktif AC-N-3-A-dan AC-N-3-B pada sampel karbon aktif akibat doping nitrogen saat aktivasi kimia.
5. Pada kedua sampel, baik variasi doping nitrogen pada proses karbonisasi hidrotermal maupun doping nitrogen saat proses aktivasi kimia, diperoleh nilai Lc yang berada pada rentang yang sama, namun pada nilai La, sampel AC-N-3-B memiliki nilai La yang lebih kecil yaitu sebesar 1,59 nm dibandingkan dengan nilai La pada AC-N-3-A yaitu sebesar 2,62 nm.

5.2 Saran

Dari penelitian ini, terdapat beberapa saran yang dapat dipertimbangkan antara lain sebagai berikut:

1. Perlu dilakukan analisis SEM-EDX untuk mengetahui morfologi dan komponen dari sampel, sehingga dapat mendukung hasil analisis FTIR.
2. Perlu dilakukan variasi temperatur karbonisasi dan aktivasi, untuk mengetahui temperatur optimum N-*Doped* karbon aktif.
3. Perlu dilakukan analisis XPS untuk mengetahui kandungan gugus nitrogen pada sampel.
4. Perlu dilakukan analisis elektrokimia untuk mengetahui kinerja karbon aktif yang paling baik untuk penggunaan superkapasitor.

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