Tailoring Hierarchical Porous Carbon Electrode from Carbon Black via 3D Diatomite Morphology Control for Enhanced Electrochemical Performance

Eugene Sefa Appiah[a, b*], Kwadwo Mensah-Darkwa[a, c*], Anthony Andrews[a], Frank Ofori Agyemang[a], Martinson Addo Nartey[a], Katlego Makgopa[d], Yongdan Hou[e, f*] Patrick Aggrey[g], David Ato Quansah[h]

[a]Department of Materials Engineering, College of Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana: appiaheugenesefa@gmail.com; kmdarkwa.coe@knust.edu.gh; anthonydrews@gmail.com; foagyemang88@gmail.com; maddonartey@knust.edu.gh.

[b]Department of Sustainable Mineral Resource Development, University of Energy and Natural Resources, Sunyani, Ghana: appiaheugenesefa@gmail.com

[c]The Brew-Hammond Energy Centre, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana; kmdarkwa.coe@knust.edu.gh

[d]Department of Chemistry, Faculty of Science, Tshwane University of Technology, Pretoria, South Africa; Makgopak@tutac.za

[e]Hubei Key Laboratory of Energy Storage and Power Battery, and School of Materials Science and Engineering, Hubei University of Automotive Technology, Shiyan, China; yongdan.hou@huat.edu.cn

[f]Shiyan Industrial Technology Research Institute of Chinese Academy of Engineering, Shiyan, China; yongdan.hou@huat.edu.cn

[g]Hierarchically Structured Materials Laboratory,Skolkovo Institute of Science and Technology, 121205 Moscow, Russia; Patrick.aggrey@skoltech.ru

[h]Department of Mechanical Engineering, College of Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana; daquansah.coe@knust.edu.gh

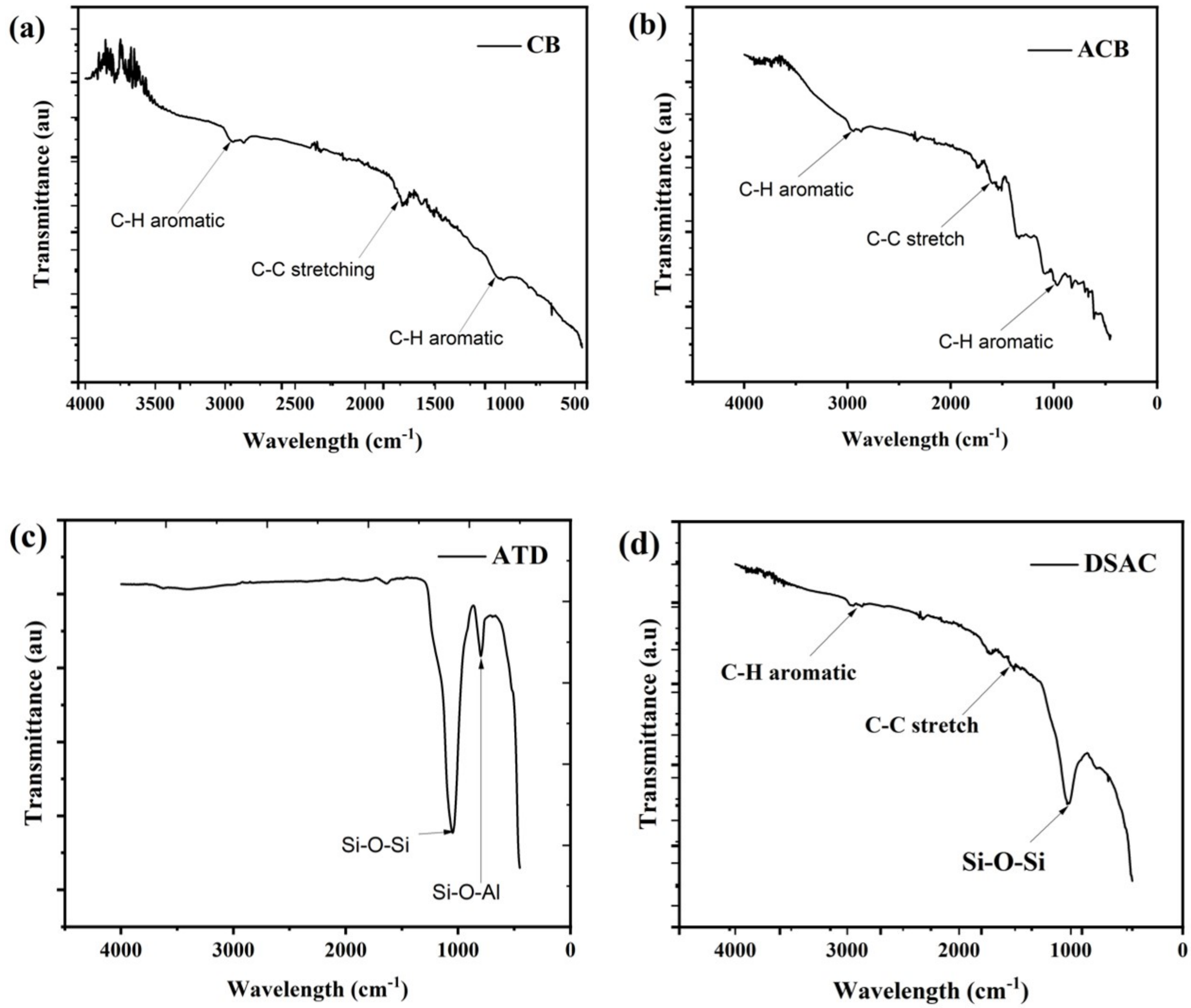

Figure S1. Fourier transmission infrared transmittance of (a) CB, (b) ACB, (c) ATD, and (d) DSAC samples

Figure S1 (a-d) shows the FTIR spectra of the CB, ACB, ATD, and DSAC samples plotted individually to reveal the various functional groups and thier respective wavenumbers as described in the **Figure 2** within the manuscript.

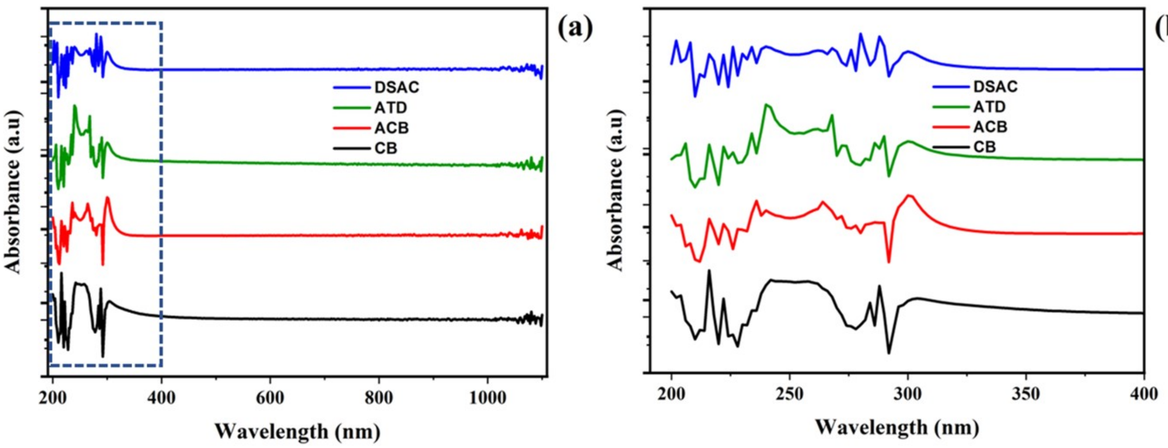

Figure S2. (a) UV-Vis absorption spectra of CB, ACB, ATD, and DSAC samples and (b) zoomed-in section of Figure (a) at a wavelength of 200 to 400 nm.

The UV-Vis absorption spectra of the CB, ACB, ATD, and DSAC samples with a zoom-in section are displayed in **Figure S2** showing variations between the wavenumber of 1050 to 1100 nm resulting from equipment wave changes [1] for all the samples. The studied samples (CB, ACB, ATD, and DSAC) have both saturated and unsaturated compounds at near 200 nm and 400 nm wavelength respectively (see **Figure S2 (a)** and **(b)**). Thus, the saturated compound in the studied samples comprises of carbon-carbon single bonds saturated with hydrogen atoms as observed in CB ACB, and DSAC samples. However aside from the saturated carbons, the DSAC sample also exhibited Si-O-Si and Si-O-Al functional groups as revealed in Fourier transmission infra-red (FTIR) spectra (see **Figure S1**) whereas unsaturated compounds include double-bonded, triple-bonded, and free radical compounds resulting from the production process of CB or the presence of impurities in CB [2] where revealed in **Figure S2**.

References

1. Han D, Meng Z, Wu D, Zhang C, Zhu H (2011) Thermal properties of carbon black aqueous nanofluids for solar absorption. Nanoscale Res Lett 6:1–7

2. Sharif Sh. M, Golestani Fard F, Khatibi E, Sarpoolaky H (2009) Dispersion and stability of carbon black nanoparticles, studied by ultraviolet-visible spectroscopy. J Taiwan Inst Chem Eng 40:524–527