**Annealing Optimization of Graphitized Hierarchical Co3O4@CuO@NiO for Supercapacitor Electrodes**

Raphael M. Obodoa,b,c, Jude N Udeha, David C. Iwueked, M. Ramzane, Rufus Ijehf, Ishaq Ahmadb,c,g, M. Maazag,h and Fabian I. Ezemaa,g,h,i[[1]](#footnote-1)\*

aDepartment of Physics and Astronomy, University of Nigeria, Nsukka, 10001, Enugu State, Nigeria

bNational Center for Physics, Islamabad, 44000, Pakistan.

cNPU-NCP Joint International Research Center on Advanced Nanomaterials and Defects Engineering, Northwestern Polytechnical University, Xi'an, 710072, China.

dDepartment of Physics, Federal University of Technology, Owerri

eDepartment of Physics, Allama Iqbal Open University, Islamabad, Pakistan

fDepartment of Physics, University of Delta, Agbor

gNanosciences African Network (NANOAFNET) iThemba LABS-National Research Foundation, 1 Old Faure Road, Somerset West 7129, P.O. Box 722, Somerset West, Western Cape Province, South Africa**.**

hUNESCO-UNISA Africa Chair in Nanosciences/Nanotechnology, College of Graduate Studies, University of South Africa (UNISA), Muckleneuk Ridge, P.O. Box 392, Pretoria, South Africa

iAfrica Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka

**Abstract**

Recently, carbon derivatives addition in electrodes fabrication enhanced performance of newly fabricated electrodes applied in energy storages electrode materials.We formed a composite ofCo3O4@CuO@NiO and graphene oxide (GO) using hydrothermal technique. Annealed synthesized electrodes at different temperatures and examine various electrodes for supercapacitor application using three-electrode system. The Co3O4@CuO@NiO composite electrode annealed at 100 ºC demonstrates better performance compared to pristine and other temperatures. The results presented a specific capacitance of the Co3O4@CuO@NiO electrode annealed 100 ºC at 1312 F/g from cyclic voltammetry (CV) testing using 10.0 mV/s scan rate and 1258 F/g from galvanostatic charge discharge (GCD) at 1.0 A/g current density. Electrode annealed at 100 ºC also exhibited higher cycling stability of 92.5 % after 10, 000 cycles showing that annealing at 100 ºC improved electrodes properties.

**Key Words:** Graphene Oxide, Hydrothermal, Electrodes,Supercapacitor, Specific Capacitance.

1. \*Author to whom corresponding should be addressed (F.I. Ezema):

   E-mail address: [raphael.obodo@unn.edu.ng, fabian.ezema@unn.edu.ng](mailto:raphael.obodo@unn.edu.ng,%20fabian.ezema@unn.edu.ng),

   +2348037321864 or +2348036239214 [↑](#footnote-ref-1)