

Size-dependent charge storage of graphene flakes

Geraldine S. C. Chan a, 1, Gomaa A. M. Ali a,b, 1, Danella Eunice Tang a, H. Algarni c,d, Chong Kwok Feng a,*

a Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, Gambang, 26300, Kuantan, Pahang, Malaysia.

b Chemistry Department, Faculty of Science, Al-Azhar University, Assiut, 71524, Egypt

c Research Centre for Advanced Materials Science (RCAMS), King Khalid University, Abha 61413, P. O. Box 9004, Saudi Arabia

d Department of Physics, Faculty of Sciences, King Khalid University, P. O. Box 9004, Abha, Saudi Arabia

* Corresponding Authors: Tel.: +609 5492403. Fax: +609 5492766.

E-mail: ckfeng@ump.edu.my

1 G.S.C. Chan and G.A.M. Ali contributed equally to this work as first authors

Abstract

This paper focuses on the charge storage properties of reduced graphene oxide (rGO) in different flake sizes. Sonication is used to exfoliate rGO into different flake sizes, as confirmed by the spectroscopy and microscopy techniques. The oxygen-related functionalities on rGO samples are quantified by Fourier transform infrared spectroscopy and reveal that higher amount of unreduced oxygen functionalities can be found on rGO with smaller flake size. The charge storage properties of rGO in different flake sizes are studied by cyclic voltammetry, galvanostatic charge discharge and electrochemical impedance spectroscopy. The findings demonstrate that the rGO with smaller flake size possesses higher charge storage capability (238 F g^{-1} at $x \text{ A g}^{-1}$), as compared to that of rGO with larger flake size (147 F g^{-1} at $x \text{ A g}^{-1}$). Apart from larger surface area contribution, the unreduced oxygen functionalities in rGO with smaller flake size also plays an important role in contributing pseudocapacitance effect to the rGO. The current findings add substantial understanding of rGO flake size effect towards electrochemical properties..

Keywords: Carbon, Exfoliation, Pseudocapacitance, Supercapacitor, Double Layer Capacitance.