Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information for

Mechanism of a Green Graphene Oxide Reduction with Reusable Potassium Carbonate

by

Dongning He[a], Zheng Peng[*,a,b], Wei Gong[a], Yongyue Luo[a], Pengfei Zhao[a] and Lingxue Kong[*,b]

[a] Agricultural Product Processing Research Institute, Chinese Academy of Tropical Agricultural Sciences, Zhanjiang 524001, China

[b] Institute for Frontier Materials, Deakin University, Waurn Ponds, VIC 3216, Australia

Fig. S1. The color change of exfloliated GO suspension in different procedure. A) is GO; B) is GO heated at 90 °C for 2 h; C) is GO mixed with K2CO3 solution and heated at 90 °C for 2 h.

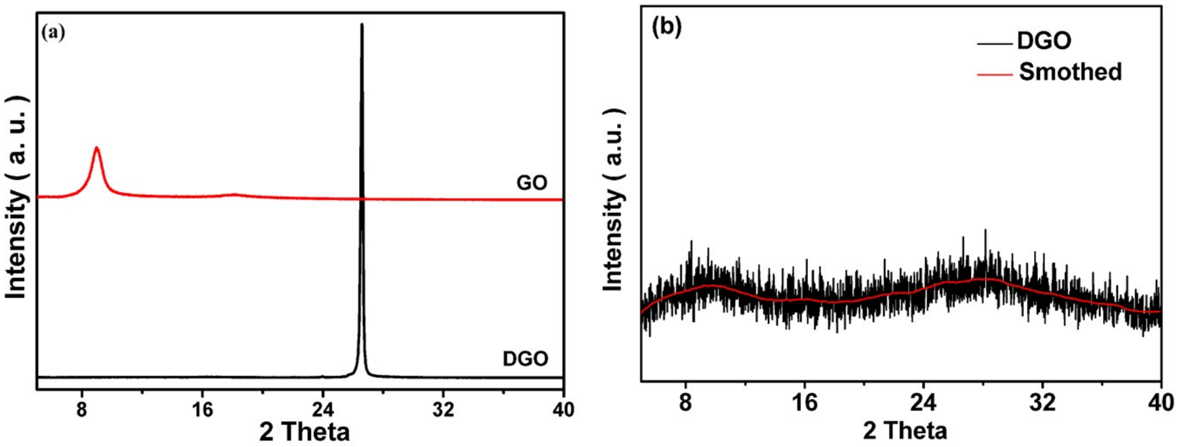

Fig. S2. The XRD patterns of graphite, GO (a) and DGO (b). The XRD patterns present a dominant peak at 2θ= 26.61 ° from graphite powder, corresponding to an interlayer distance of 0.33 nm, while the peak of GO is at 8.96 °, which equals to the distance of 0.99 nm. XRD patterns of DGO show two weak peaks around 9.64 ° and 27.26 °, corresponding to an interlayer spacing about 0.92 nm and 0.33 nm, respectively. It indicates that DGO mainly involves graphene.

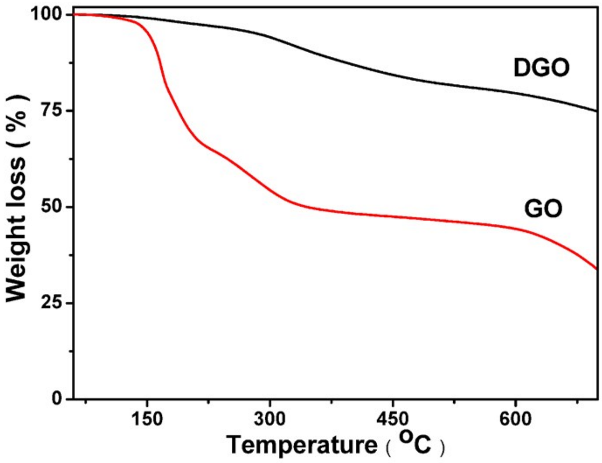

Fig. S3. TGA curves of the GO and DGO. The different weight loss turns in TGA curve of GO may come from the different oxygen function groups breakdown from the GO flakes as described in the proposed reduction mechanism. After reducing, the TGA curve of DGO seen much more flat compared to that of GO. 66.58 % weight loss at 700 °C is observed for GO, while 25.21 % is found for DGO, suggesting that most of the labile oxygenous groups have been removed from the GO to form graphene.

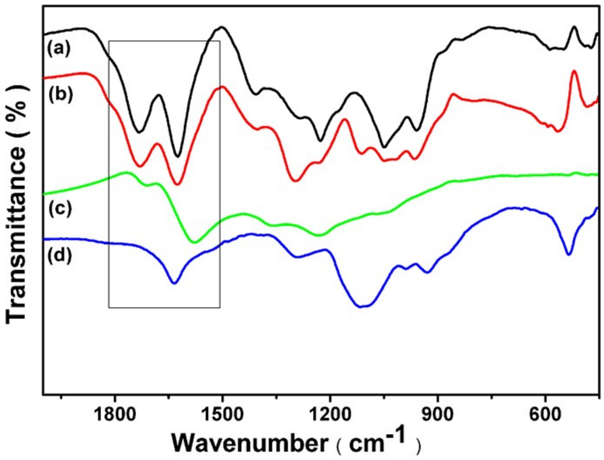

Fig. S4. FTIR spectra of samples from different controlling experiments. Controlling experiment A) heating the GO suspension in air condition (the oxygen can solve in the water); controlling experiment B) heating the GO suspension in nitrogen condition (the oxygen can only come from the surface of the GO that is absorbed with π-πconjugate bonds). It was found that GO suspensions of A and B remain color of dark brown, indicating there is no ionic oxygen to launch the deoxygenation of GO when K_2CO_3 is not introduced into the system as demonstrated by FTIR spectra. Controlling experiment C) heating the GO suspension mixed with K_2CO_3 solution in nitrogen condition; controlling experiment D) heating the GO suspension mixed with K_2CO_3 solution in air condition. It was found that the color of GO suspensions of C and D changes to black, and the FTIR patterns show sample of C is completely deoxygenated while that of D still remains carbonyl groups, suggesting when K_2CO_3 is introduced, the ionic oxygen can generated with ionization and electrochemical reactions.

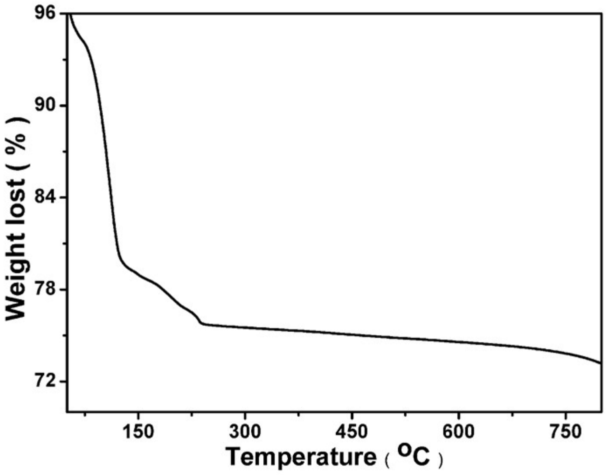

Fig. S5. TGA Curves of K_2CO_3 after being reused for 4 rounds under oxygen. After being reused for 4 times, the solution is collected and dried in a freeze drier and ready for TGA test. The weight loss before 120 °C corresponds to the water inside of the sample, while that between 120-230 °C to the typical weight loss of $KHCO_3$. The deoxygenation of GO can generate carbon dioxide, which is absorbed by K_2CO_3 and produces $KHCO_3$ with the formula of $K_2CO_3 + CO_2 + H_2O \longrightarrow 2KHCO_3$, and the $KHCO_3$ can reverse to K_2CO_3 with the formula of $2KHCO_3 \rightarrow K_2CO_3 + CO_2 + H_2O$ when it is heated.