Electronic Supplementary Material (ESI) for Journal of Materials Chemistry

Supporting Information for:

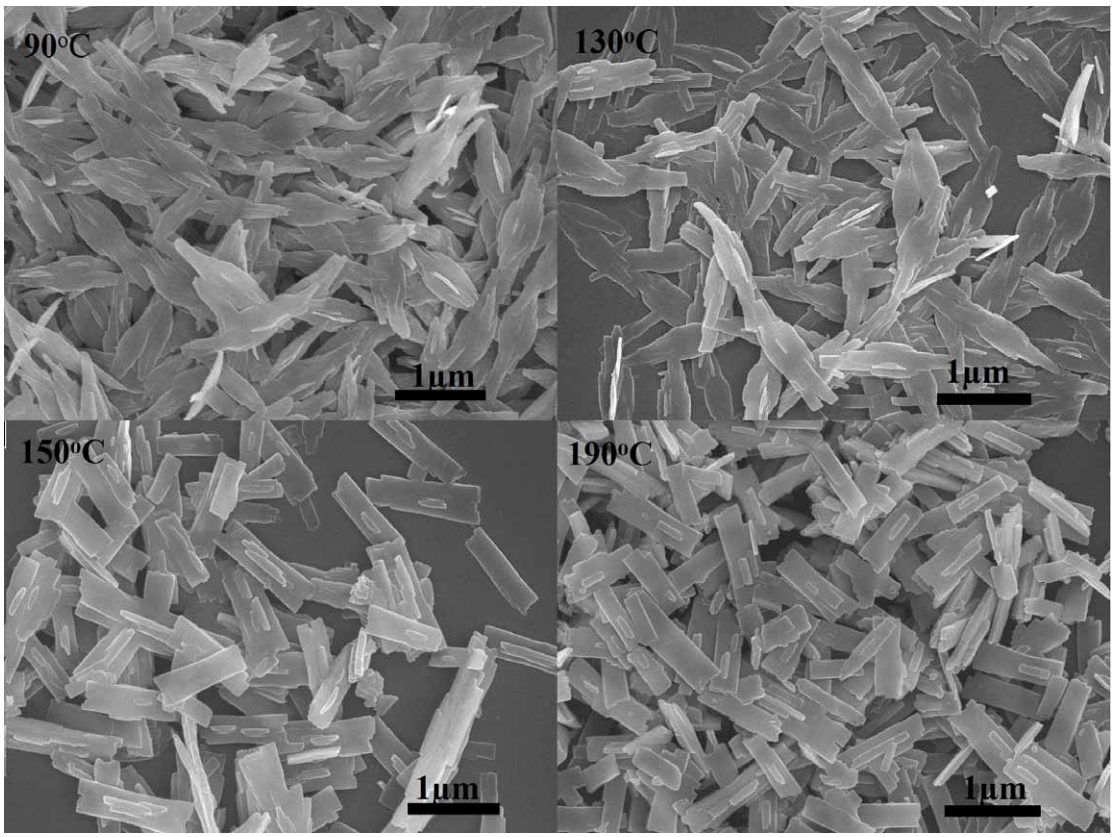
Sheet-like and fusiform CuO nanostructures grown on graphene by rapid microwave heating for high Li-ion storage capacities

Li Qiang Lu and Yong Wang*

Supporting Information 1.

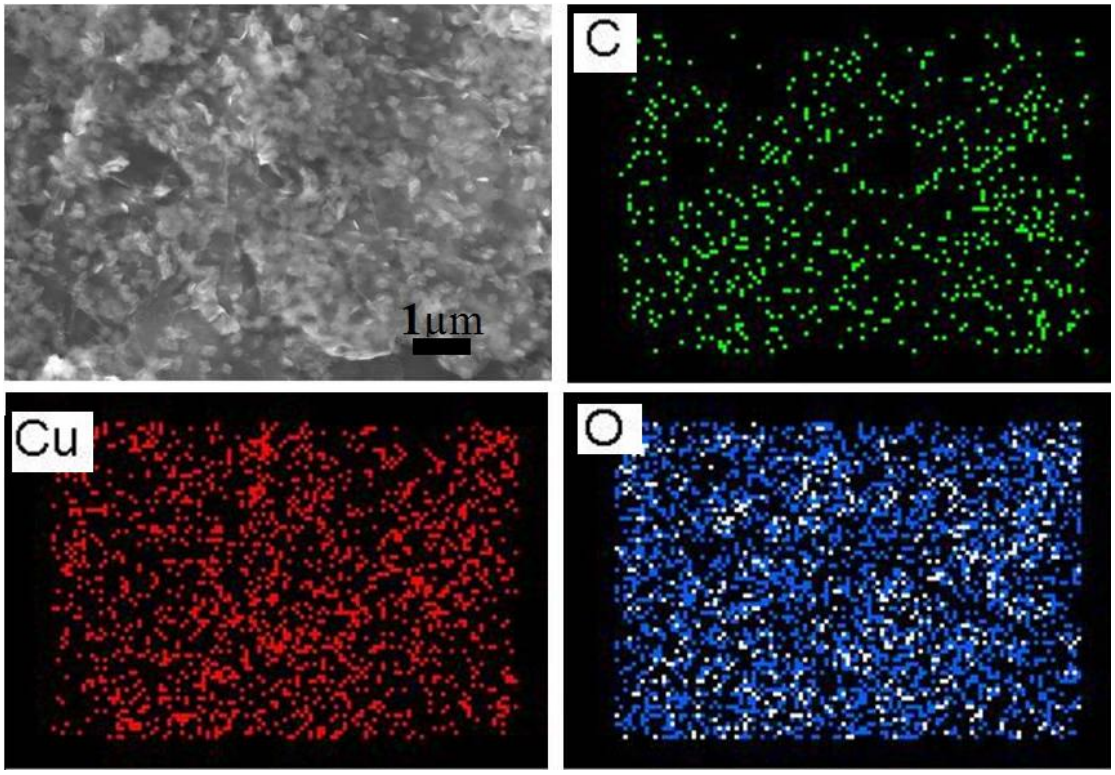
The following SEM images show the morphology evolution of CuO at various microwave-heating temperatures of 90°C, 130°C, 150 °C, and 190°C. The product morphologies prepared at 110 °C and 170 °C are shown in the Figure 3a-d in the main text.

With the increased temperature from 90 °C to 190 °C, the CuO morphologies tended to change from fusiform structure to rectangle. The temperature of 150 °C was the critical temperature to obtain rectangle CuO.



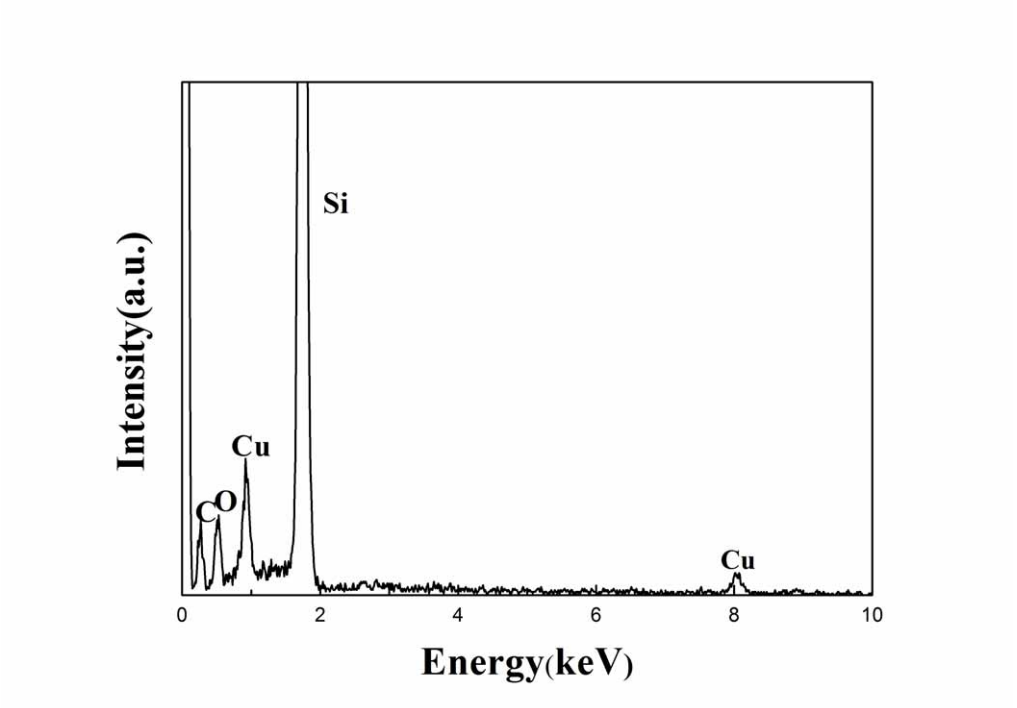
Supporting Information 2.

The following EDS element mapping was used to confirm the uniform dispersion of CuO nanosheets on graphene nanosheets (GNS).



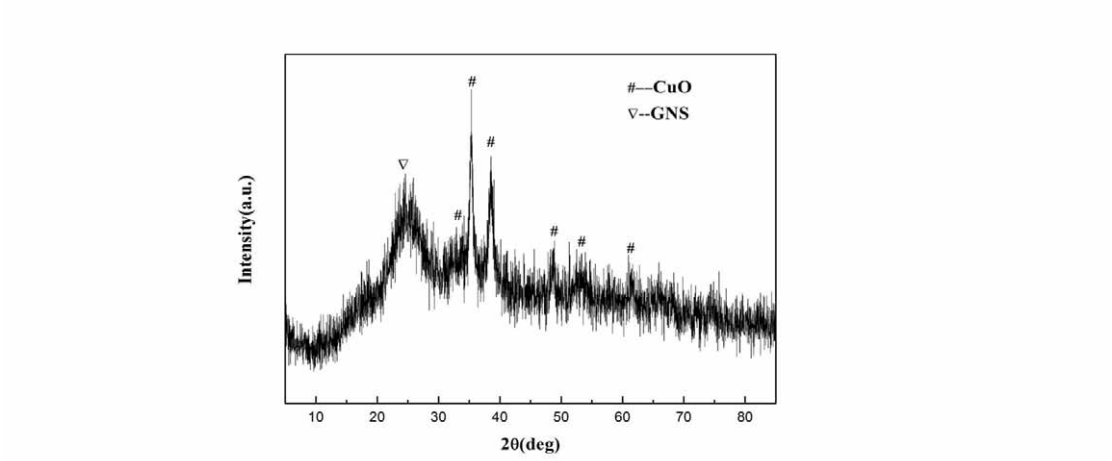
Supporting Information 3.

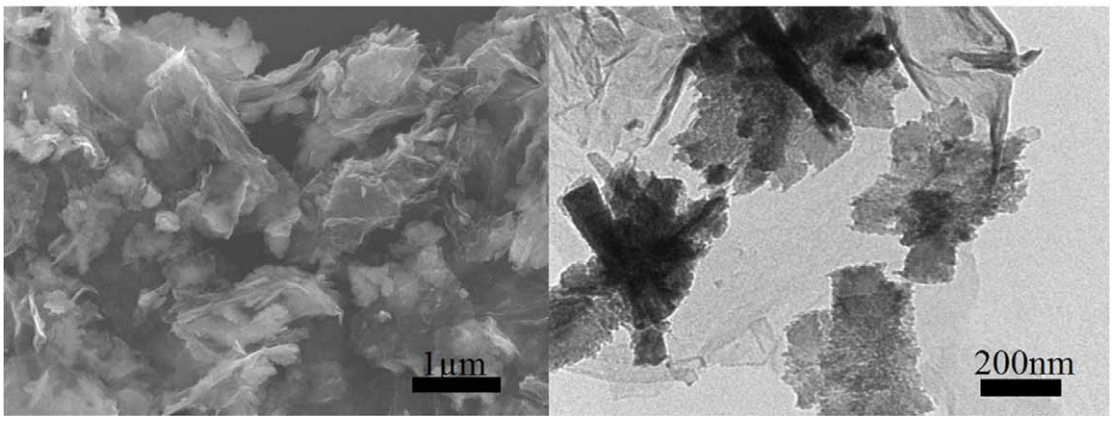
The following figure shows the EDS spectrum of CuO nanosheets-GNS composite. The Cu, O, C elements are present. The calculated weight ratio of CuO to C was 1.03 to 1, close to the theoretical value of 1:1. The Si element came from the substrate to disperse SEM samples, thereby the effect of common carbon paste was removed.



Supporting Information 4.

The following figures show the XRD pattern, SEM image, and TEM image of the CuO-GNS composite, which was fabricated at a low temperature of 60 ^{o}C by the microwave-assisted method. A broaden characteristic (002) peak of GNS was present at ~23-25^{o} in the XRD pattern. A few other peaks could be indexed into CuO (PDF 05-0661). These peaks intensities were much lower compared to the CuO products prepared at 110 ^{o}C and 170 ^{o}C (Figure 2a in the main text) due to the comparatively low reaction temperature. The CuO nanosheets were composed of numerous small nanoparticle nanowires in these microscopic images.

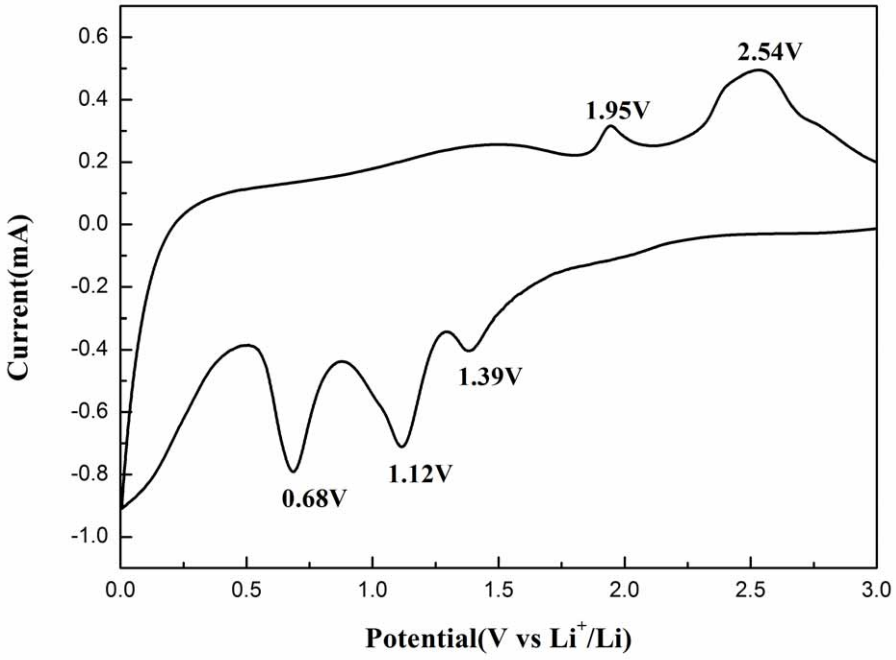




Supporting Information 5.

The following figure shows the Cyclic voltammetry of GNS/CuO nanosheets, which was carried out on a CH Instruments electrochemical workstation (model 660D) at a scan rate of 0.1 mV /s. A few characteristic cathodic peaks at 1.39, 1.12, 0.68 V were observed, corresponding to the reduction reaction of CuO to Cu_2O and Cu embedded in Li_2O matrix and the formation of SEI film. Two anodic peaks were observed around ~1.95 and 2.54V, which was ascribed to the decomposition of Li_2O and the corresponding oxidation of Cu to Cu_2O and CuO. These observations agree well with previous report.[18,23] The corresponding reversible reactions can be described as follows:

$$2CuO + 2Li^+ + 2e^- \leftrightarrow Cu_2O + Li_2O$$
$$Cu_2O + 2Li^+ + 2e^- \leftrightarrow 2Cu + Li_2O$$



Supporting Information 6

The following TEM images show the CuO nanosheets-GNS composite (top) and pristine fusiform CuO electrode (bottom) after cycling. The conductive agent (carbon black) and binder materials (PVDF) were also present. It is concluded that CuO nanosheets were retained after repetitive cycling in the presence of GNS, however fusiform CuO electrode without GNS support was almost crushed after cycling.