Supporting Information

Synthesis and Electrochemistry of Highly Pseudocapacitive Carbon Nano Onions aka Multilayer Fullerenes and its MnO_2 nanocomposite

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1. *Comparative CV of CNOs, MnO_2/CNOs and carbon paper:*

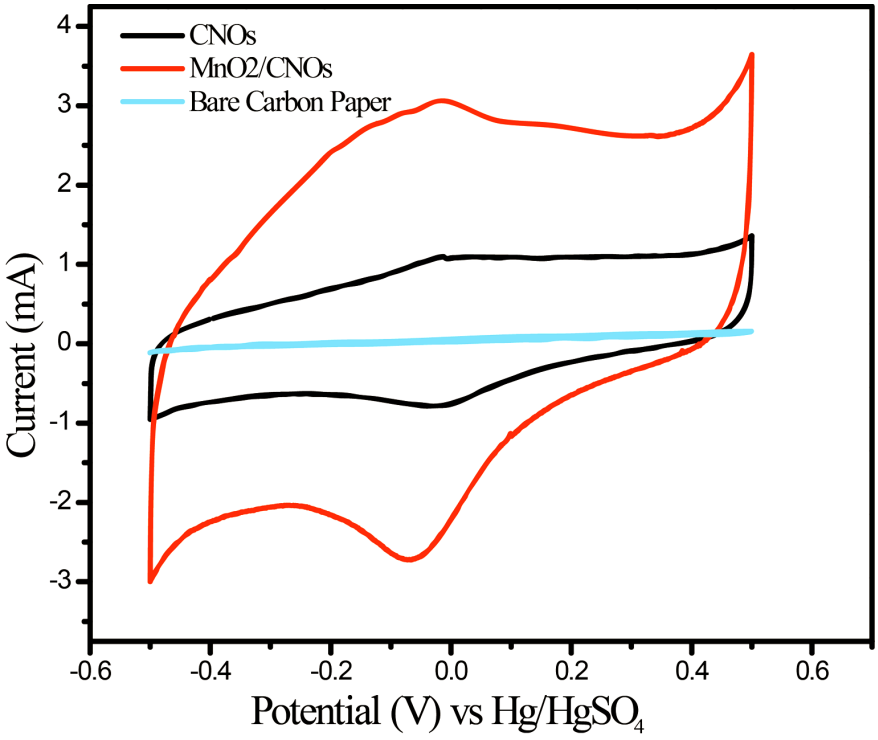

Figure S1. Comparative cyclic voltamogram shows the contribution of bare carbon paper which was used as the current collector at the scan rate of 5mV/s.

2. *Surface area analysis:*

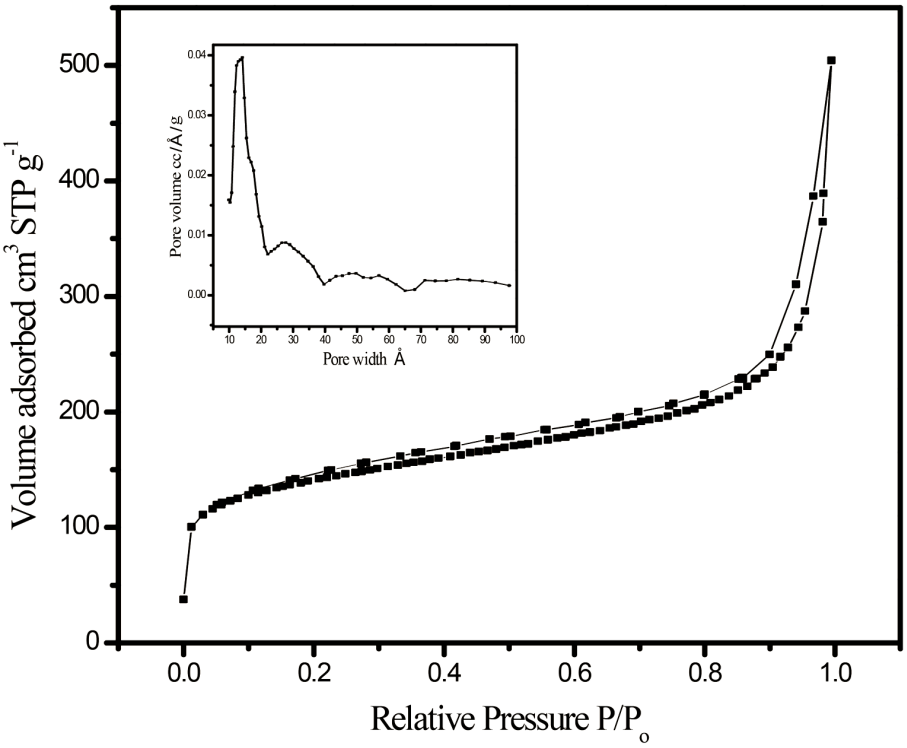

Figure S2. Nitrogen sorption isotherms at 77 K and the Inset shows pore size distributions of CNOs.

By using Brunauer-Emmett-Teller (BET) theory and Density Functional Theory (DFT) on the collected nitrogen-adsorption isotherms, pore size and the surface area distributions were calculated. For N_2-sorption measurements, Autosorb-iQ automatic volumetric instrument was performed at 77 with pressures in the range 0–760 Torr. The calculated average pore size of CNOs chain structure is ranging from 1.2-1.4 nm. CNOs exhibit VI isotherm and it has surface area of 486m^2g^{-1}.

3. *HRTEM images of CNOs:*

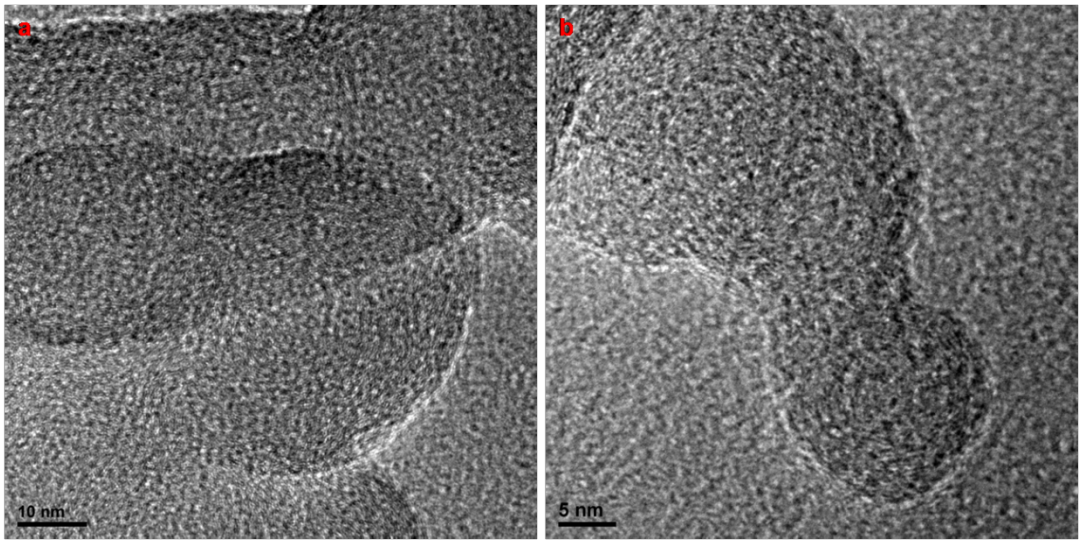

Figure S3. HRTEM images of CNOs showing **(a)** completed ring of multilayer fullerene and **(b)** fused fullerene rings

4. *TEM images of thermal carbon black:*

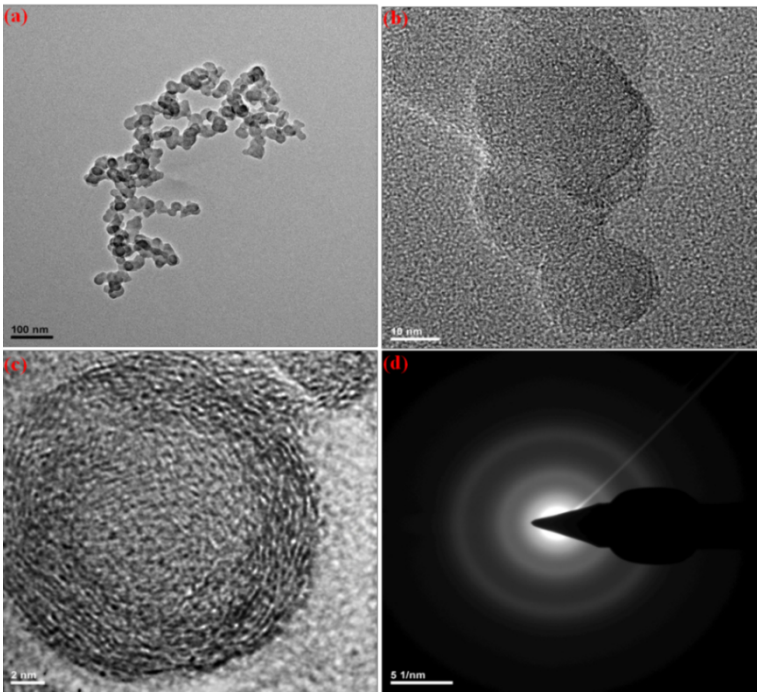

Figure S4. (a,b,c) Shows the HRTEM images of as collected thermal carbon black **(d)** shows the SAED pattern of the CNO, the inter atomic distance calculated is 0.34nm; corresponding to (002) plane of carbon.

5. *Thermal gravimetric analysis (TGA):*

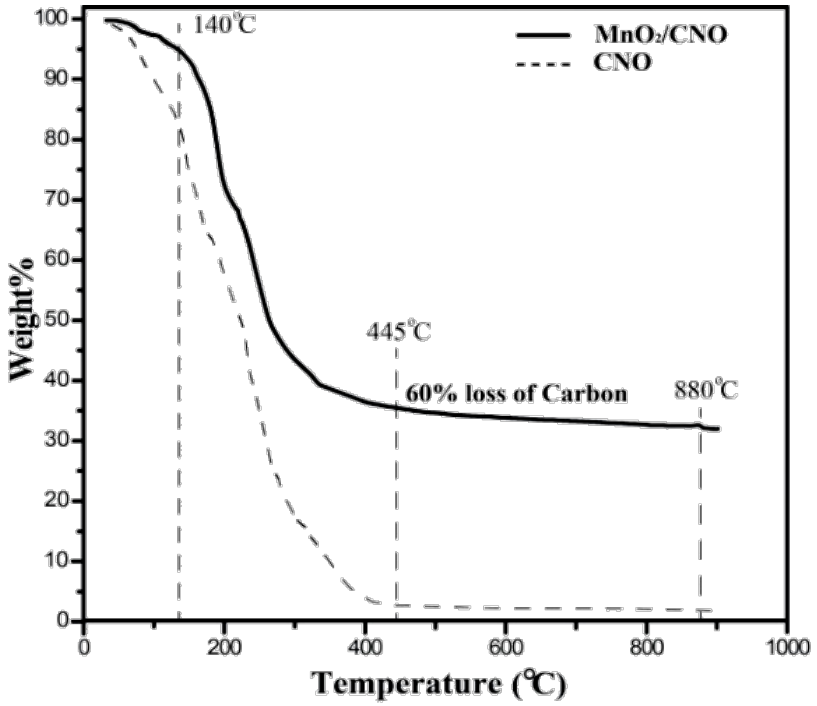

Figure S5. Thermogravimetric analysis (TGA) of CNOs and its composite MnO_2/CNOs before annealing at 800°C.

For MnO_2/CNOs composite 5% weight loss has been observed between 30 and 140 °C that is attributed to the liberation of adsorbed water molecules from the composites. Low onset potential shows pyrolysis of organic residue. Further weight loss of 60% up to 445 °C corresponds to the loss of organic residues in CNOs. In addition, we have observed a final weight loss of 1% after 880 °C is due to the conversion of MnO_2 to Mn_3O_4[Xiaofeng Xie, Lian Gao, 'Characterization of a manganese dioxide/carbon nanotubes composite fabricated using an in situ coating method', *Carbon*, 45, (2007) 2365–2373.]

6. *XPS of MnO2/CNOs composite:*

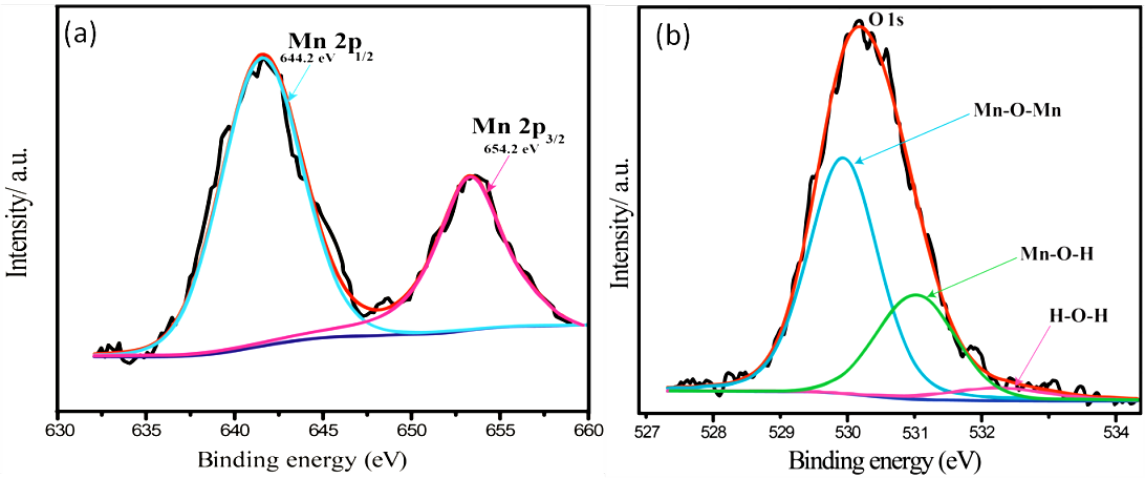

Figure S6. XPS spectra of MnO_2/CNOs composite.

The XPS measurements have been taken to study the components and oxidation states of CNOs and MnO_2/CNOs composite. In figure (a) the binding energies 644.2 eV and 654.2 eV Corresponding to Mn 2p band for the binding energies $2p_{1/2}$ and $2p_{3/2}$ which proves that the Mn in the composite is having oxidation state IV. The XPS of O 1s the has been deconvoluted into three components (fig b); the binding energy at 529.86 eV gives the evidence for Mn-O-Mn bonds for the tetravalent oxide which has highest intensity among others and the another binding energy at 531.19 eV shows that the hydroxide group has been bound to manganese Mn-OH; the binding energy at 532.48 eV corresponds to H-O-H bonds.

7. *SEM images of precursor ghee, thermal carbon black and CNOs:*

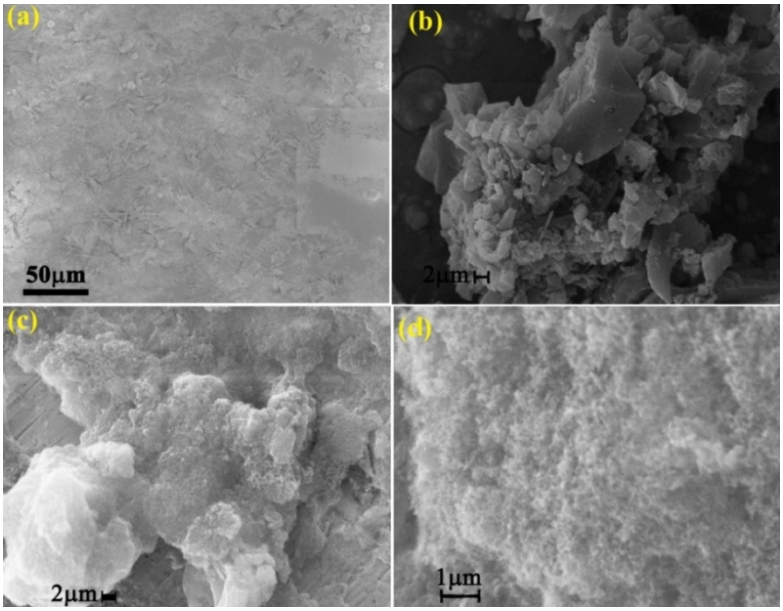

Figure S7. SEM images of (a) ghee (butter oil), (b as collected thermal black carbon and (c), (d) CNOs after annealing t at 800°C.