Carbon nanotubes and other low dimensional carbons for energy harvesting, conversion and storage

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In this talk I will show a brief view of three different applications related with energy in which low dimensional carbons like carbon nanotubes and graphene nanoribbons[1] are involved. The first one is related with the capture of waste heat produced in chemical industry at relatively low temperature (≤ 130 °C) by using carbon nanotubes in both electrodes (positive and negative) in thermocells.[2] The second one provides a new procedure for making nanotube electrodes for energy storage applications by using a biscrolling procedure of nanotube sheets from spinnable nanotube forests.[3] Generically applicable biscrolling methods are demonstrated for producing yarns comprising up to 99 wt % of otherwise unspinnable nanopowders or nanofibers that remain highly functional. These methods utilize the strength and electronic connectivity of down to 1 wt % of carbon nanotube sheet that is helically scrolled in the yarn. This new technology is used to make yarns of graphene ribbons, high performance battery materials and catalytic nanofibers for fuel cells. The last part of this talk will show the latest developments on nanotechnology research for electrochemical energy storage (supercapacitors and alkaly-ion batteries) that we are carrying out in CIC energiGUNE.

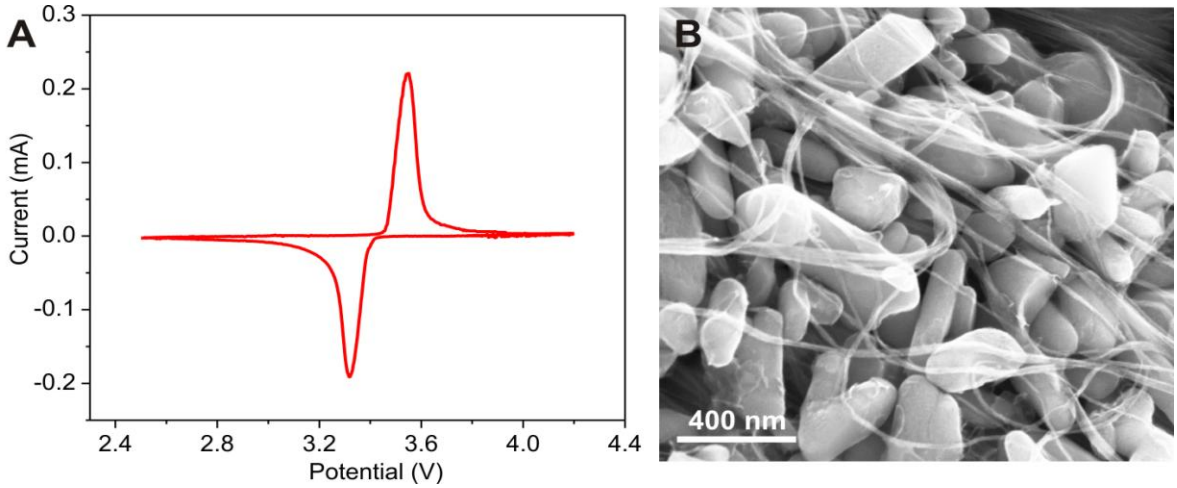

Fig. 1. (A) Cyclic voltammogram of a 95% $LiFePO_4$@$MWNT_{4,6}$ biscrolled yarn between 2.5 and 4.2 V at 0.1 mV/s in an electrolyte containing 1 M $LiPF_6$ in a 1:2:3 by volume mixture of propylene carbonate, ethylene carbonate, and dimethylcarbonate, respectively. (B) SEM micrograph of the surface of a 94% $LiFePO_4$@$MWNT_{2,1}$ biscrolled yarn, showing $LiFePO_4$ particles contacted by a web of MWNTs.

References:

1. Oriented Graphene Nanoribbon Yarn and Sheet from Aligned Multi-Walled Carbon Nanotube Sheets, Javier Carretero-Gonzalez et al., ***Adv. Mater.*** 8 November, 2012, 5695-5701.

2. Harvesting Waste Thermal Energy Using a Carbon-Nanotube-Based Thermo-Electrochemical Cell, Renchung Hu, et al. ***Nano Lett.,*** 10, 2010, 838-846.

3. Biscrolling Nanotube Sheets and Functional Guests into Yarns, *Lima, et al.* ***Science*** 7 January 2011: 51-55.