Structural differences between few-layer graphene oxide suspensions obtained from carbon nanotubes and fishbone nanofibers

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Abstract

Graphene-based materials combine extreme mechanical strength with exceptional thermal and electronic conductivities and total impermeability to gases. These characteristics make them very attractive for numerous applications such as electronics, sensors, energy-storage materials, composites or catalytic supports. Synthesis of graphene oxide from graphitic carbon using chemical routes followed by ultrasonic exfoliation allows processing in liquid suspension. This opens the possibility of its industrial production where reduced graphene can be obtained in a final reduction step. Carbon nanofilaments (CN) can be used for graphene obtention as an alternative to the use of synthetic graphite, whose environmental sustainability and cost are penalized by the use of coke from petroleum processing and graphitization treatment at high temperature (> 2500 ° C), respectively. In this work, multi-wall carbon nanotubes (MWCNT), and fishbone carbon nanofibers (CNF) (structures shown in Figure 1) generated by catalytic decomposition of methane in a rotating bed reactor using a Fe-Mo/MgO and Ni/Al_2O_3 catalyst, respectively, were subjected to oxidation and exfoliation to obtain few-layer graphene oxides (FLGO, Figure 1). FLGO were obtained using a modified Hummers method [1], under a ratio of oxidation of $KMnO_4$/CN = 6 (wt.) [2], followed by ultrasonic exfoliation. Homogeneous FLGO suspensions from expanded nanofilaments were separated by centrifugation at 2000 rpm in supernatant and precipitate, respectively. The products obtained were characterized by Raman spectroscopy, XRD, SEM and TEM. This synthesis strategy resulted in different exfoliation mechanisms depending on the starting CN: MWCNT showed an easier exfoliation, resulting in FLGO flakes, while fishbone CNF resulted in expanded CNF and small FLGO sheets after separation at 2000 rpm. The exfoliation degree is attributed to the different plane arrangement and lateral dimension of the graphene layers in the nanofilaments.

References

[1] W.S. Hummers, R.E. Offeman, JACS, **80** (1958) 1339.
[2] D. Torres, J.L. Pinilla, R. Moliner, I. Suelves, Carbon, **81** (2015) 405.

Figures

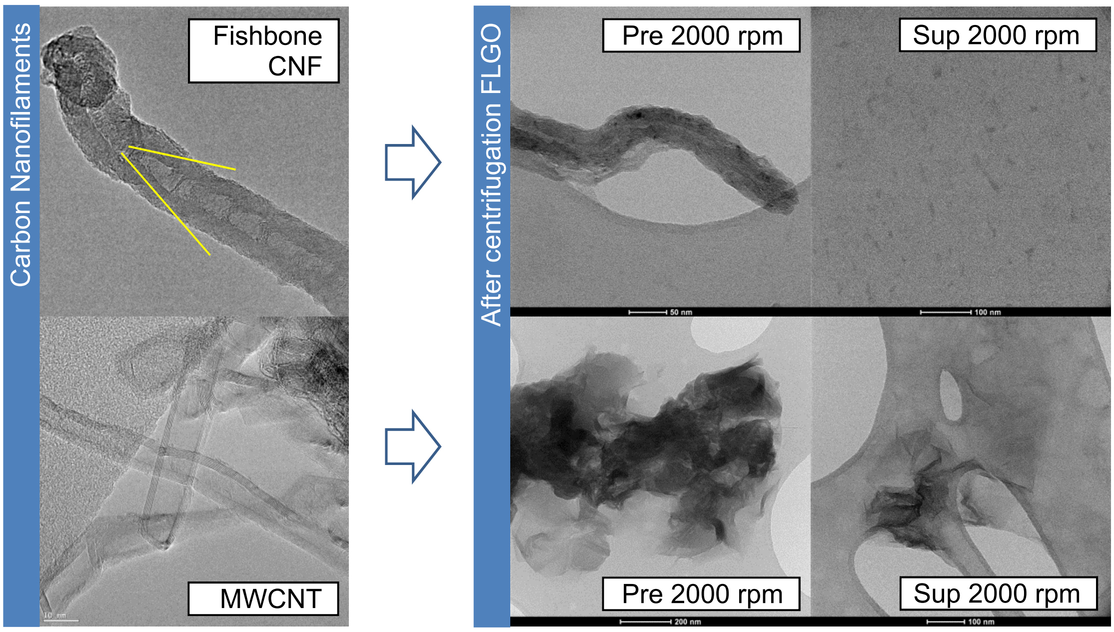

Figure 1. FLGO products obtained at 2000 rpm from fishbone CNF and MWCNT.