

## High quality graphite oxide produced by Nacional de Grafite LTDA.

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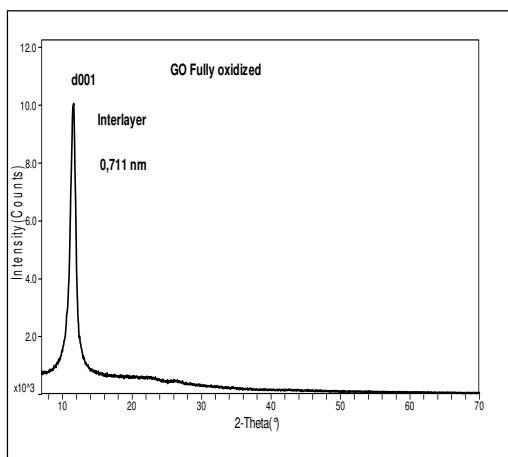
In this work we are going to show the high quality of the graphite oxide (GO) produced by Nacional de Grafite LTDA (NGL). It is prepared in a pilot plant with capacity to produce 20 pounds per month. The method was the modified Hummers's method<sup>[1]</sup> and the techniques used in the characterization were: X Ray Diffraction, BET, Raman, SEM, TEM and XPS.

Graphite oxide, formerly called graphitic oxide or graphitic acid, is a compound of carbon, oxygen, and hydrogen in variable ratios, obtained by treating graphite with strong oxidizers. The maximally oxidized bulk product is a yellow solid with C:O ratio between 2.1 and 2.9. The bulk material disperses in basic solutions to produce monomolecular sheets, known as graphene oxide (fig2).<sup>[3]</sup> Graphene oxide sheets have been used to prepare a strong paper-like material, and have attracted substantial interest as a possible intermediate for the manufacture of graphene.

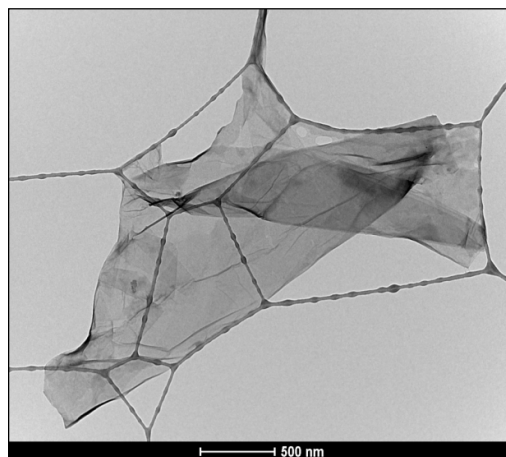
Graphite oxide was first prepared by Oxford chemist Benjamin C. Brodie in 1859, treating graphite with a mixture of potassium chlorate and fuming nitric acid<sup>[4]</sup>. In 1957, Hummers and Offeman developed a safer, quicker, and more efficient process, using a mixture of sulfuric acid H<sub>2</sub>SO<sub>4</sub>, sodium nitrate NaNO<sub>3</sub>, and potassium permanganate KMnO<sub>4</sub>, which is still widely used, often with some modifications.

It should be noted that graphite oxides demonstrate considerable variations of properties depending on degree of oxidation and synthesis method. For example, temperature point of explosive exfoliation is generally higher for graphite oxide prepared by Brodie method compared to Hummers graphite oxide, the difference is up to 100 degrees at the same heating rates. Hydration and solvation properties of Brodie and Hummers graphite oxides are also remarkably different.

The structure and properties of graphite oxide are directly related to the synthesis method and the degree of oxidation. The GO typically preserves the layer structure of the raw material (natural graphite), although the interlayer spacing becomes two times larger (~0.7 nm). (fig1)



**Fig 1- X Ray Diffraction of GO**



**Fig 2 - Transmission Electron Microscopy of GO**

Several process parameters determine the characteristics of the graphite oxide obtained by the modified Hummers's method. The control of these parameters is necessary to obtain the most appropriate GO for different applications like supercapacitors, catalyst, solar energy, graphene semiconductor chips, conductive graphene film, graphene computer memory, Biomaterials, transparent conductive coatings. Finding the best GO for each need is the key to make the use of this material a reality in the near future.

Nacional de Grafite Ltda holds one of the largest reserves of high quality natural graphite in the world. It has an R & D center with specialists in graphite. This group works in partnership with graphene characterization specialists from the Physics Department at the Federal University of Minas Gerais (UFMG) and nanocarbon synthesis specialists from the Nanocarbon Laboratory at the CDTN. The result of this project is the NGL availability to supply a high quality GO to the development of new materials.

Keywords: graphite oxide, Hummers's method, natural graphite

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**Acknowledgments:** This research was supported by NGL, the Brazilian Agencies CNEN, CNPq, FAPEMIG, CAPES, the Brazilian Nanocarbon Institute, the Brazilian Network on Carbon Nanotube Research, and the Microscopy Center of UFMG.

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