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Expanded Graphite Prepared with Microwave Radiation: Time Effect on its Oil Adsorption Capacity

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Exfoliated graphite (EG) is prepared introducing some intercalation compounds (normally sulfates and oxides) into the laminar honey bee structure of graphite and a subsequent thermal shock. This carbon form constituted an important industrial material for flexible gasket, seals and packing manufacturing. Also, it is a promising electronic material in the form of few-layer carbon structures. Still, the quantitative exfoliation to produce a pristine single-layer material has remained one of the main challenges in developing and practical synthesis routes [1]. Lately, EG has been demonstrated its excellent adsorbent properties, especially for organics with large molecular chains and low polarities like oil and petroleum products. Due to EG's evident advantages and unique properties for industrial applications, a sustainable, economical, and scalable production route is necessary to prepare high-quality graphite adsorbents. The exfoliation of layered graphite constituted a volumetric expansion up to hundreds of times, generating impressive crystallographic delamination along its c axis. Usually, there is a fast and sudden expansion of the intercalation agent exerting the intermolecular forces of adjacent layers of graphite during the exfoliation process, creating an accordion-like material with low density, high-temperature resistance lubricity and flexibility [2]. A recent and convenient method for the thermo-mechanical exfoliation of functionalized graphites to produce graphene oxides and EG is the microwave irradiation method. This selective and solvent-less route takes advantage that microwave irradiation violently exfoliates the chemically modified graphite [3]. This work describes a route to obtain GE using the microwave irradiation route as a function of time and the resulting adsorption capacity against a light oil. EG was produced putting 100 mg of commercial graphite (Sigma-Aldrich #808121) in a domestic microwave (Frigidaire model FMDL17S4GL700W), varying the processing times from 5 to 60 s, and the expanded samples were checked as adsorption agents following the method reported by Bi et al. [4]. The morphologic studies were performed using a Hitachi SU3500 microscope.

Fig. 1 shows the morphological features of the exfoliated graphite before and after the thermal expansion. Initial functionalized graphite has the characteristic flake-like morphology after the heating process is noticeable the formation of worm-like particles, induced by the microwave heating process, where the decomposition byproducts such as H_2O, CO_2 SO_x and other gases generate an intense pressure that exceeds the van der Waals forces that hold together graphite layers, obtaining a spontaneous and rapid graphite expansion in a single preferential axis. Fig. 2 shows two plots of the calculated volume after the expansion in mL per gram of material as a function of time. An optimal volume was obtained after 20 s of microwave heating. EGs were tested for oil adsorption to obtain a plot of its sorption capacity related to the heating time; a maximum adsorption capacity was reached with the

50 s heated sample, as seen in the graph. These results showed the benefits of using this practical and low-cost route for EG preparation.

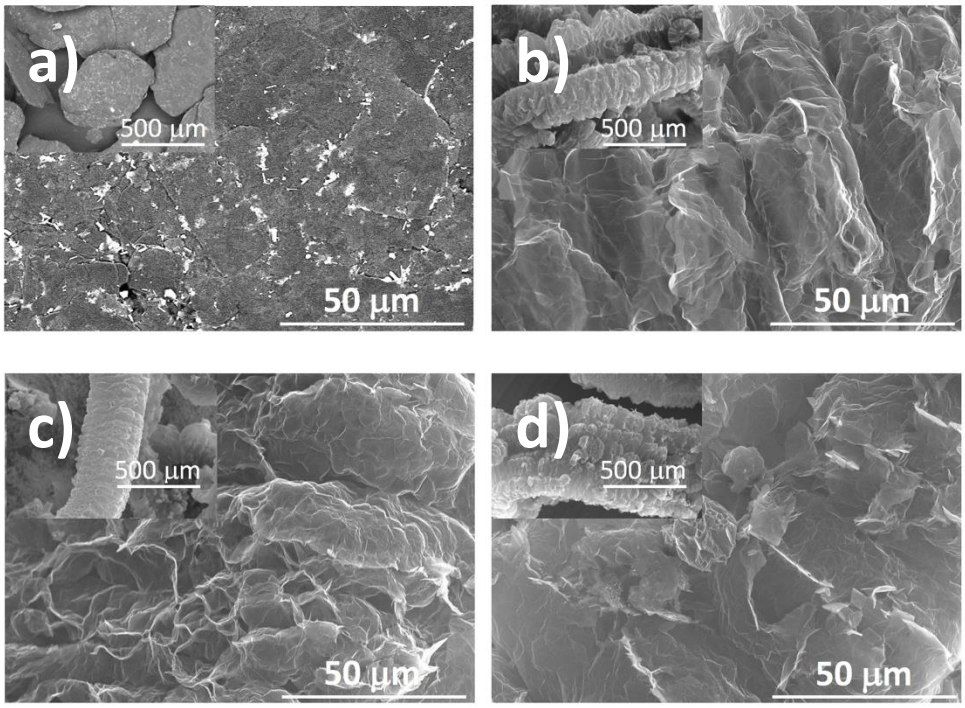

Figure 1. SEM micrographs of EG before and after the heating process: a) 0, b) 5, c) 30 and d) 50 s.

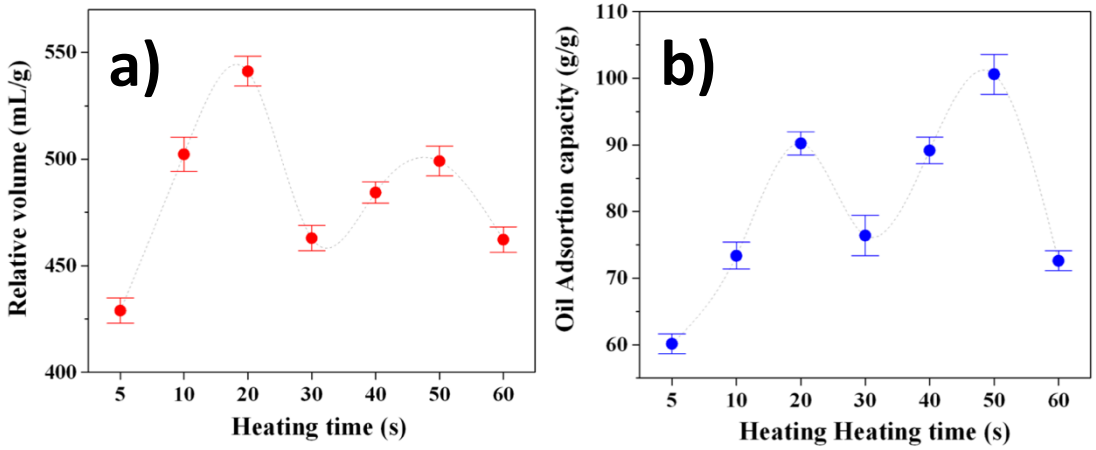

Figure 2. relative volume and oil adsorption capacity plots of EG as a function of heating time.

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