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Synthesis of graphene/hollow carbon fiber composite aerogels for oil spill cleanup

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Characterization Equipment

Morphology of the samples was observed by SEM JEOL JSM6701F. For the XRD analyses, an X-ray diffractometer, model D2 Phaser, Bruker, was used. Functional groups were studied using a FTIR Perkin Elmer Spectrum Two 2. The N_2 physisorption technique was carried out using a BELSORP mini II equipment (BEL Japan), using the Brunauer-Emmet-Teller (BET) and Barrett-Joyner-Halenda (BJH) methods.

GO characterization

GO was synthesized using the Hummers method, the product obtained was analyzed by FTIR spectroscopy, as can be seen in Figure S1 b), there is a broad band between 3000-3630 cm^{-1} characteristic of the stretching vibration of the hydroxyl groups, at 1716 cm^{-1} the band corresponding to the stretching vibration of the C=O bond is observed, at 1617 cm^{-1} the stretching vibration of the non-oxidized C=C bonds, at 1219 cm^{-1} the band corresponding to the stretching vibration of the C–O–C bonds and at 1044 and 974 cm^{-1} the bands that are attributed to the stretching vibrations of the C–O bonds were observed. As a comparison, an analysis was carried out using FTIR spectroscopy on graphite (precursor), the spectrum obtained is shown in Figure S1 a), where the absence of functional groups in the material can be observed.

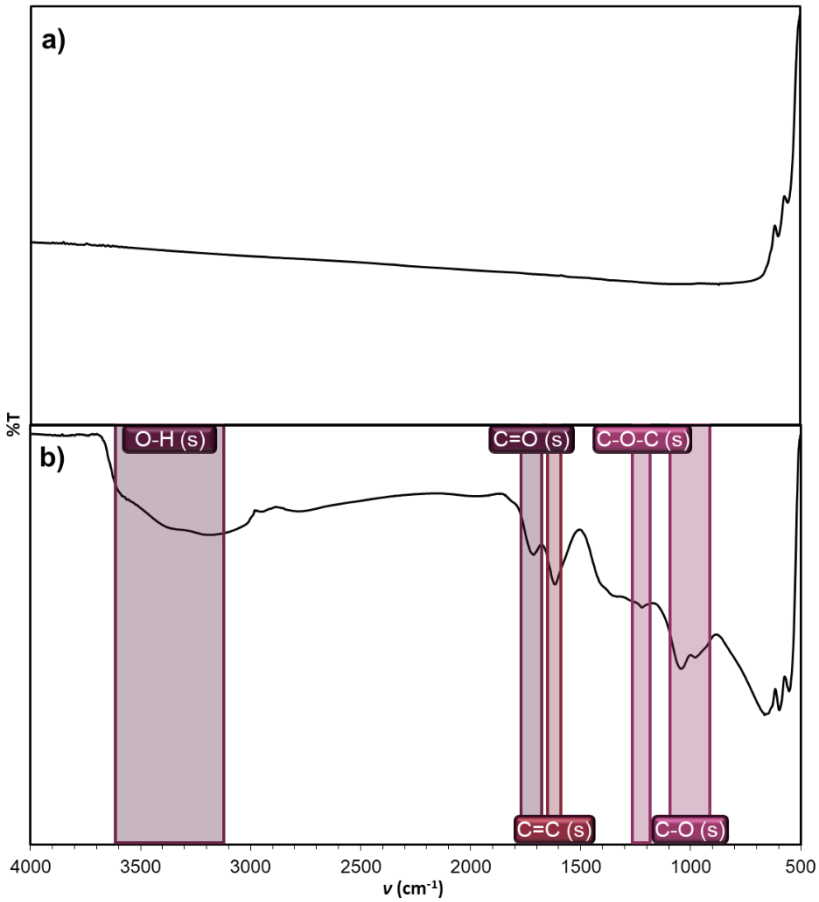

Figure S1 FTIR spectrum of a) graphite and b) GO.

X-ray diffraction analyzes were also carried out for both the graphite and the GO obtained, as shown in Figure S2 for graphite the characteristic peak corresponding to the (002) plane at 26.43° in 2θ is obtained and for GO the characteristic peak corresponding to the (001) plane at 11.52° in 2θ. The distance between the layers (d) was calculated by Bragg's law, for GO a d =7.68 Å using the peak of (001) plane and for graphite a d=3.37 Å using the peak of (002) plane were calculated. The expanded interlayer spacing of GO confirms the presence of oxygenated functional groups in GO sheets.

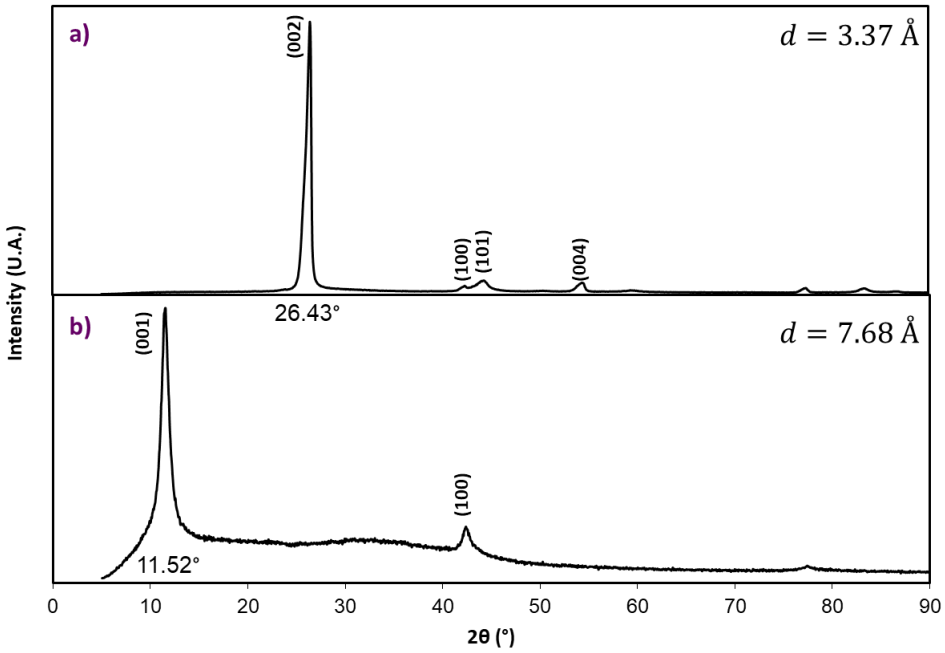

Figure S2 XRD of a) graphite and b) GO.

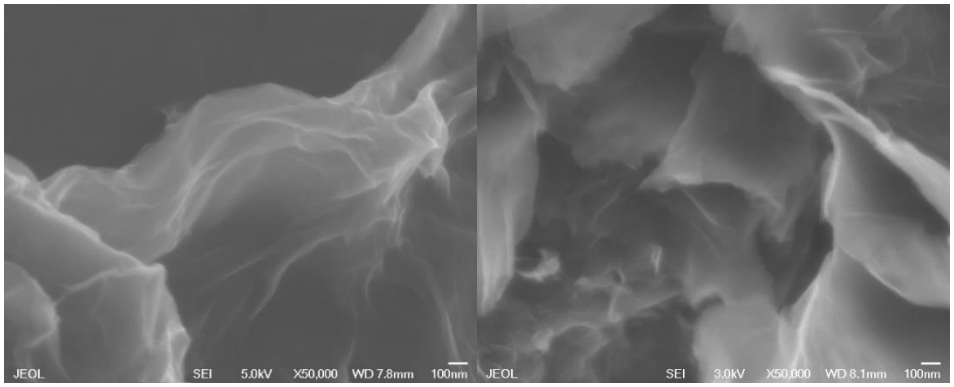

Figure S3 SEM micrographs of GO.

Characterization of hollow carbon fibers

The pyrolyzed fibers were analyzed by FTIR spectroscopy, Figure S4, the band corresponding to the stretching vibration of the C=C bonds can be observed at 1576 cm^{-1}.

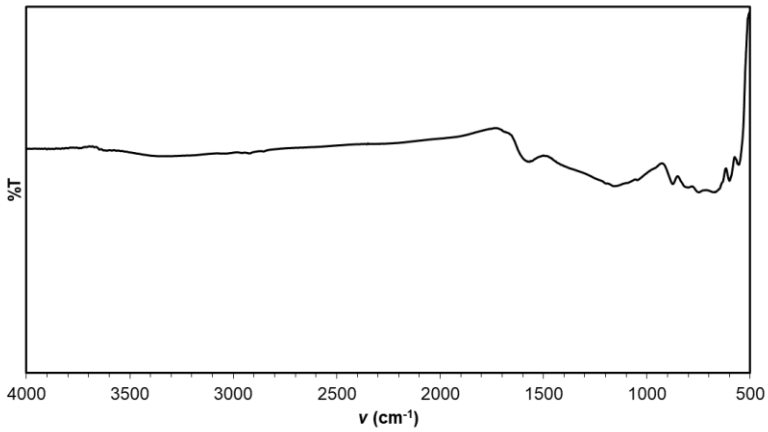

Figure S4 FTIR spectrum of pyrolyzed cotton fibers. (CF).

X-ray diffraction analyzes were also carried out, Figure S5, three peaks were obtained, the first peak between 10.5 and 11.4° in 2θ could be attributed to the (110) plane of the cellulose (precursor). The most intense peak between 23.2 and 28.4° in 2θ corresponds to the (002) plane and the peak between 40.5 and 42.7° in 2θ corresponds to the (001) plane, indicating that the material has a graphitic structure, which is characteristic of these types of materials.

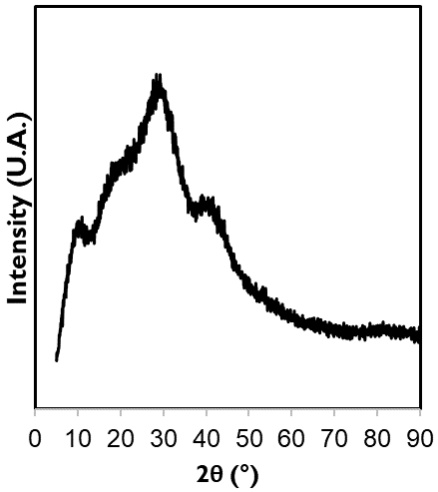

Figure S5 XRD for hollow carbon fibers obtained by pyrolysis of cotton fibers at 700 °C.

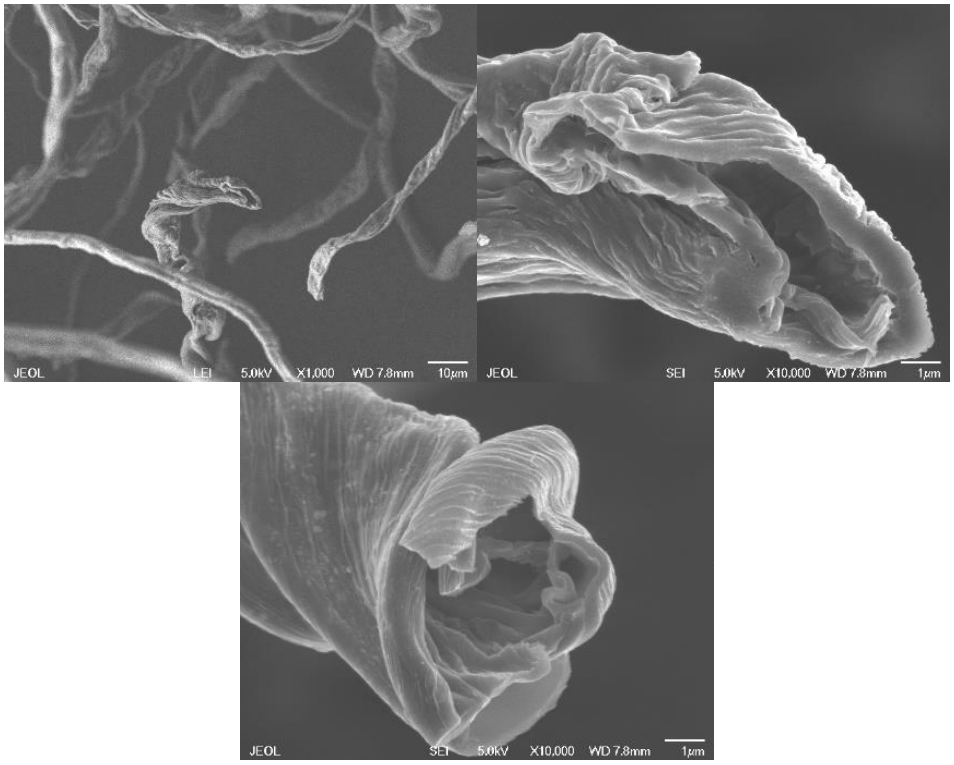

Figure S6 SEM micrographs of hollow carbon fibers obtained by pyrolysis of cotton fibers.

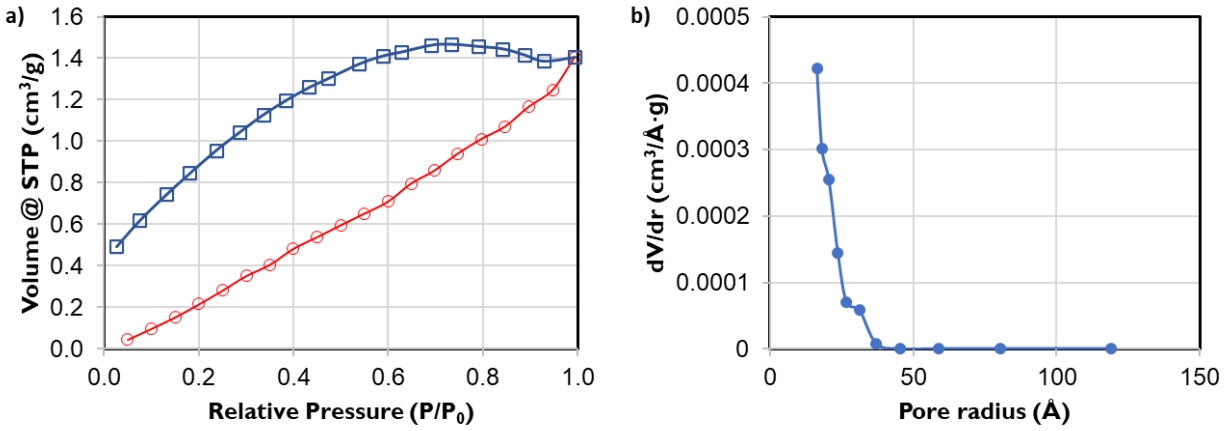

Figure S7 Nitrogen adsorption-desorption isotherm and pore size distribution of CF.

Graphene Aerogel Characterization (GA)

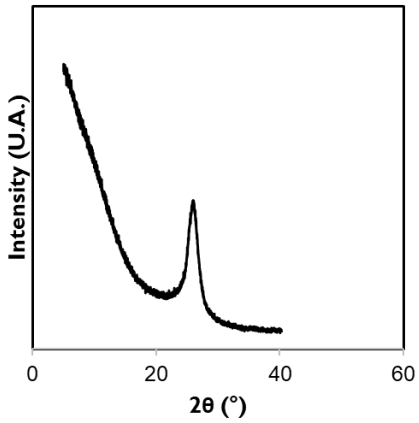

Figure S8 XRD of GA.

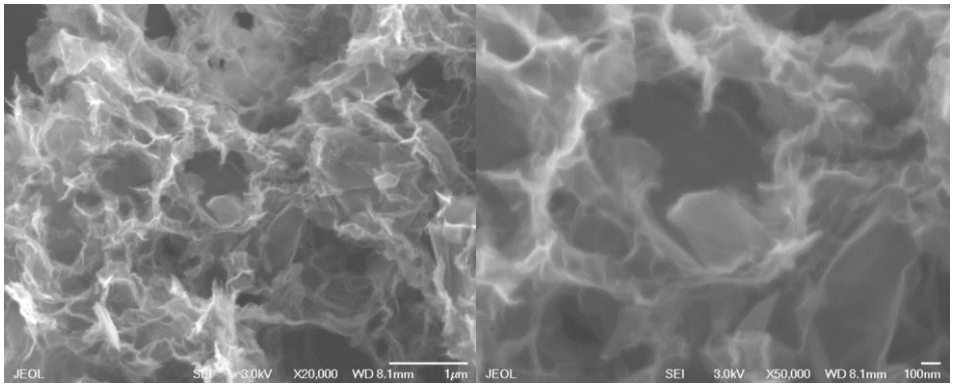

Figure S9 SEM micrographs of GA.

Characterization of G-CF

Figure S10 Digital photographs of a G-CF.

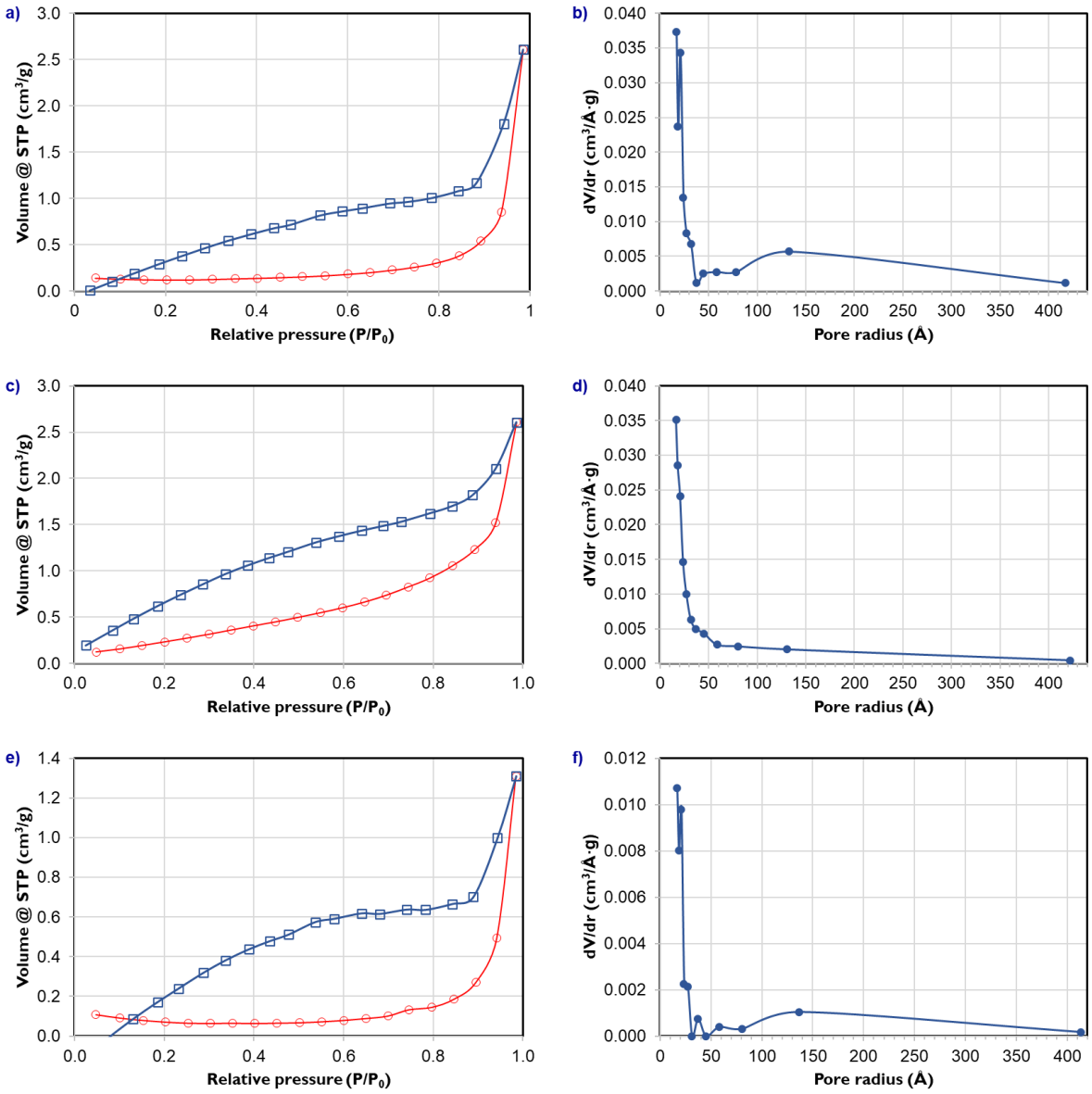

Figure S11 Nitrogen adsorption-desorption isotherms of a) GA, c) G-CF50 and e) G-CF75 and pore size distribution of b) GA, d) G-CF50 and e) G-CF75.