

Modulating the interaction of graphenic substrates with human interleukin-6 and its monoclonal antibody: A study by Raman images

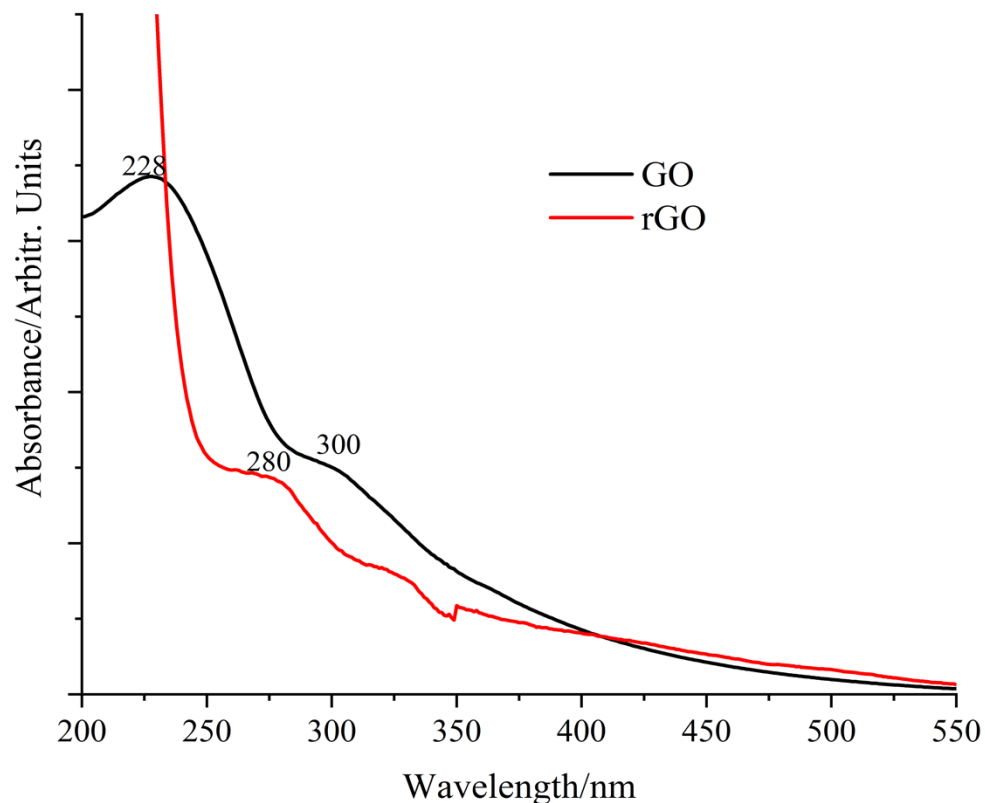


Fig. S1 UV-Vis spectra of Graphene Oxide (GO) and reduced Graphene Oxide (rGO). The spectrum of GO shows an absorption band at ~ 228 nm and a shoulder at ~ 300 nm that is attributed to the $n \rightarrow \pi^*$ transition in the C=O bonds of oxygen-containing functional groups. While, the spectrum of rGO shows an absorption band at ~ 280 nm attributed to $\pi \rightarrow \pi^*$ transitions of aromatic C=C bonds.^{1,2} The disappearance of the shoulder at ~ 300 nm and the redshift of the main band from ~ 228 to ~ 280 nm are indication of GO reduction. The spectra were recorder in water dispersion with a Cary 5000 UV-Vis-NIR Spectrophotometer.

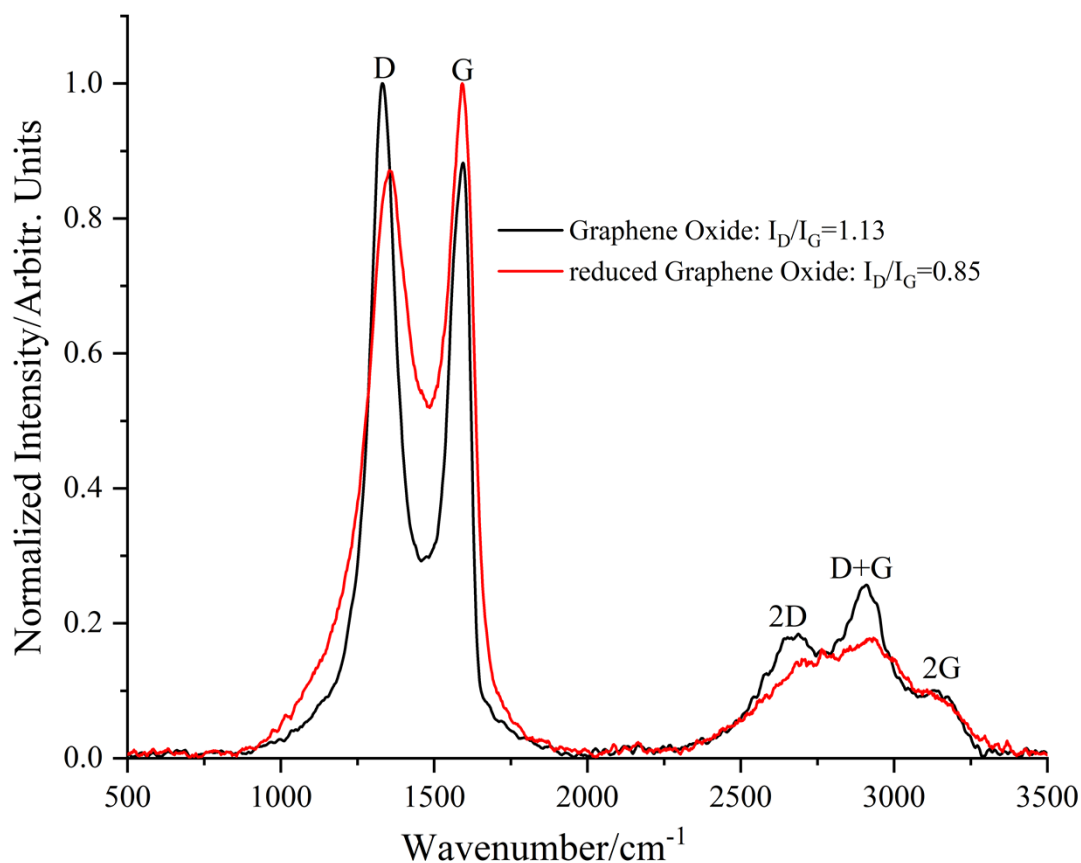


Fig. S2 Raman spectra of reduce Graphene Oxide and Graphene Oxide. Displays a D band centered at $\sim 1357 \text{ cm}^{-1}$ and $\sim 1334 \text{ cm}^{-1}$ for rGO and GO, respectively, and the G band centered at $\sim 1595 \text{ cm}^{-1}$ for both. The G peak is the characteristic of all sp^2 -hybridized carbon networks, which originates from bond stretching of sp^2 carbon in both rings and chains. The D peak is due to the breathing mode of aromatic rings, which comes from the structural imperfections created by the attachment of oxygen groups on the carbon basal plane [3,4]. The D peak in GO is mainly due to chemical functionalization and extended amounts of sp^3 C atoms, while the D peak in rGO is derived from structural defects within the carbon framework. The ratio between the D and G bands has been well established as a method to elucidate the structural organization. The relative intensity of these bands (I_D/I_G) is an estimation of the disorder level in graphene. After the thermal reduction, the I_D/I_G decreases from 1.13 (GO) to 0.85 (rGO) indicating the change in the hybridization of sp^3 to sp^2 . The 2D band at $\sim 2684 \text{ cm}^{-1}$ is a second-order two-phonon process that conforms the low number of layers of rGO and GO.^{1,2,3,4}

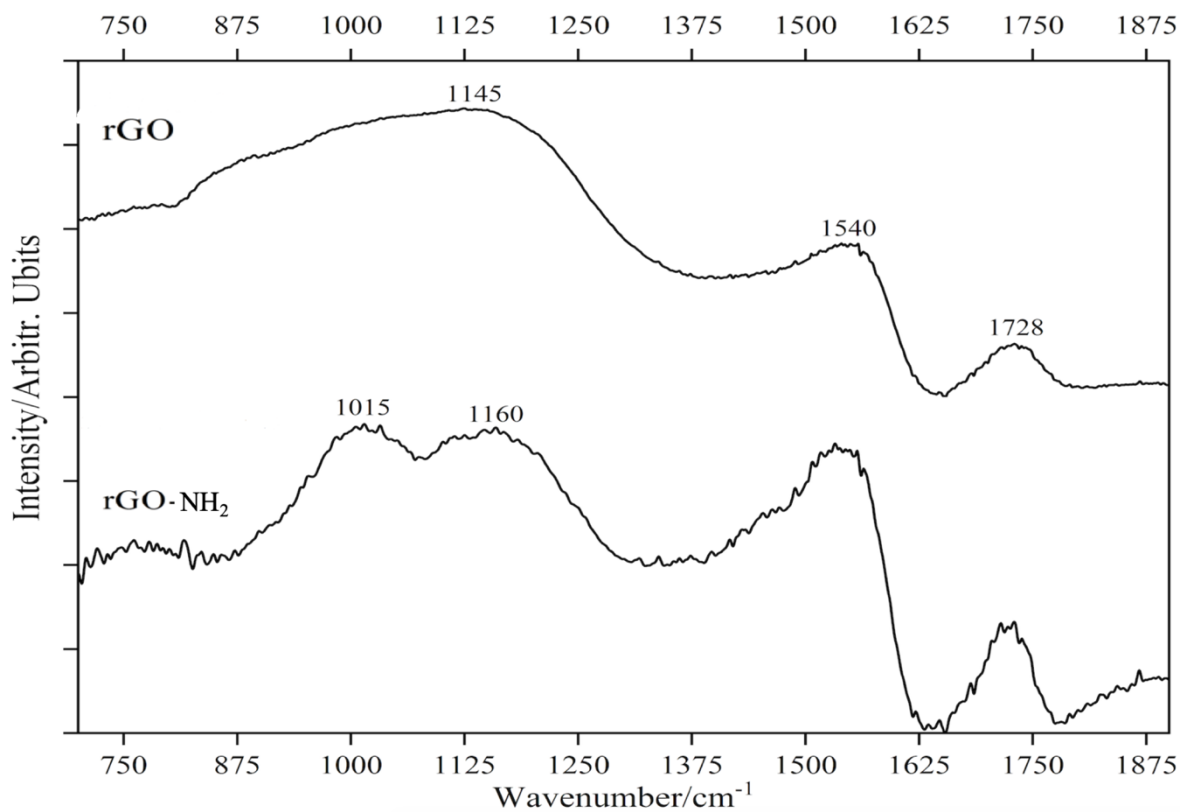


Fig. S3 In figure we can see the FTIR spectrum of rGO before (rGO) and after (rGO-NH₂) being functionalized with ethylenediamine (EDA, NH₂(CH₂)₂NH₂), we can observe two bands centered at 1015 and 1160 cm⁻¹, which are attributed to the presence of strong in-plane C-N scissoring absorptions and C-O stretching vibrations. This is due to the nucleophilic substitution of -NH₂ to the epoxide carbon and the b-carbon of -OH groups of the rGO before the functionalization, which can be appreciated by the wide band in 1145 cm⁻¹.^{5,6}

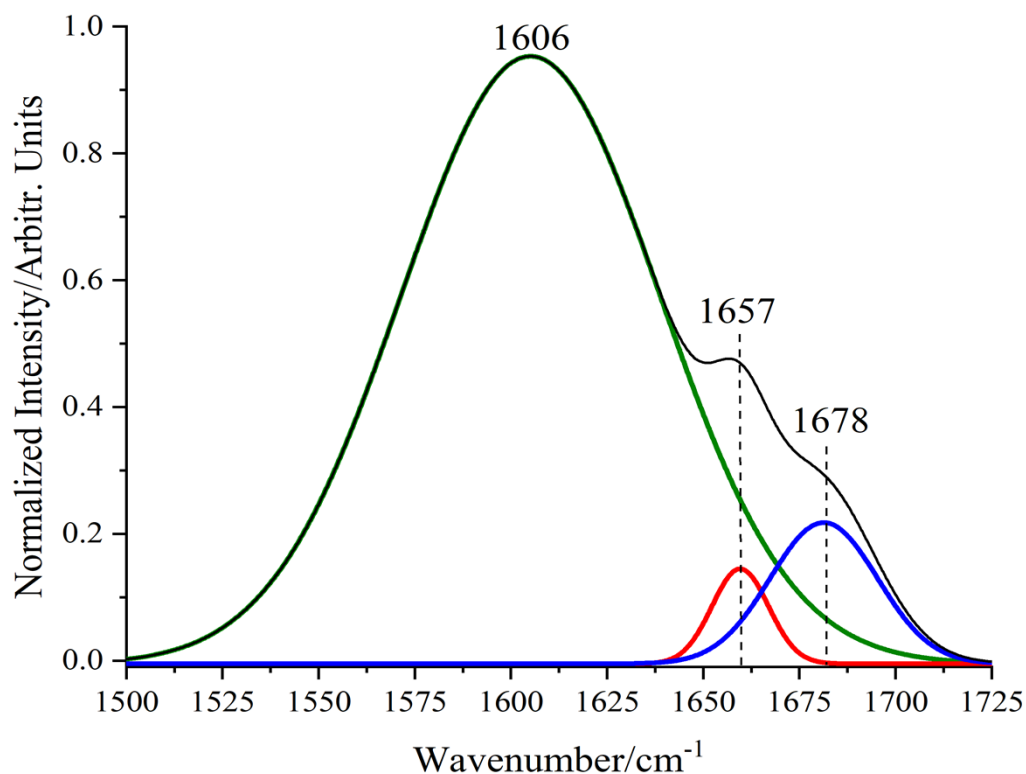


Fig. S4 The figure show the deconvolution of the complex band extended from 1500 to 1700 cm^{-1} in the Figure 3b of the manuscript. The deconvolution was performed in order to visualize the subjacent bands that compose the whole complex band. The original spectrum was baseline-corrected before the deconvolution analysis and smoothed with the Savitzky-Golay (SG) filter with five-point window. The deconvolution was performed using OriginPro 2018 software, selecting the Gaussian peak type option. The number of bands employed for this spectral analysis was defined by the second derivative of the whole band. In figure are observed three bands at 1606 cm^{-1} due to GO, at 1657 cm^{-1} due to amide I of IL-6 and 1678 cm^{-1} due to amide I of mabIL-6, see Fig. 1 in manuscript. With this analysis, we corroborate the correct and reliable bands assignment of Fig. 3b in manuscript.

References

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