## Sensitive Raman detection of human recombinant Interleukin-6 mediated by DCDR/GERS hybrid platforms

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## Supporting information

S1 Raman spectra of Graphene Oxide and reduced Graphene Oxide

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Figure S1. Raman spectra of Graphene Oxide and reduced Graphene Oxide. Displays a D band at ~1350 cm<sup>-1</sup> and a G band at ~1580 cm<sup>-1</sup>. The G peak is the characteristic of all sp<sup>2</sup>-hybridized carbon networks, which originates from bond stretching of sp<sup>2</sup> carbon pairs 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.<sup>1,2</sup> The D peak in GO is mainly due to chemical functionalization and extended amounts of sp<sup>3</sup> C atoms, while the D peak in rGO is derived from structural defects within the carbon framework. The inversion of the relative intensities of the G and D bands in the GO and rGO spectra are indicative of the GO reduction. The spectrum was recorded with a WITec Alpha 300 Series Raman-AFM, using a 672 lines/mm grating and a Nd:YVO4 green laser with wavelength of 532 nm.



Figure S2. FTIR spectra of Graphene Oxide and reduced Graphene Oxide. The spectrum of Graphene Oxide shows the presence of C=O (1721 cm<sup>-1</sup>), C-OH (1415 cm<sup>-1</sup>), the stretching vibration and deformation vibration of O-H at 3375 cm<sup>-1</sup> and 1387 cm<sup>-1</sup>, respectively. The band at 1570 cm<sup>-1</sup> is probably due to stretching vibrations of the C=C bonds of rGO.<sup>3,4</sup> The decrease in intensity of the bands associated with C=O stretching vibration (1627 cm<sup>-1</sup>) and the increase of the band intensity at 1570 cm<sup>-1</sup> associated with the C=C stretching vibrations, are indicative of the GO reduction. The spectra were recorder with a Nicolet iS50R FTIR Spectrometer with a spectral range from 525 cm<sup>-1</sup> to 4000 cm<sup>-1</sup>, and optical resolution of 4 cm<sup>-1</sup>.



Figure S3. UV-Vis spectra of Graphene Oxide and Oxide reduced Graphene Oxide. The spectrum of Graphene Oxide shows an absorption at ~230 and has 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 reduced Graphene Oxide shows an absorption peak at 260 nm attributed to  $\pi$ - $\pi^*$  transitions of aromatic C=C bonds.<sup>3,5</sup> The disappearance of the shoulder at 300 nm and the redshift of the main band from 234 to 260 nm are

indication of GO reduction. The spectra were recorder in water dispersion with a Cary 5000 UV-Vis-NIR Spectrophotometer.



Figure S4. Scheme structure of Interleukin-6 shows the  $\alpha$ -helix conformation and four cysteine residues. Taken from AS Roset et al. (2018) NGL viewer: web based molecular graphics for large complexes. Bioinformatics doi: 10.1093/bioinformatics/bty419



Figure S5. IL-6/PBS drop coat in Si. The Raman spectra were taken in the region of "coffee ring". The picture was taken with a CCD camera coupled to the optical microscope of WITec Alpha 300 Series Raman-AFM, using the 100X Zeiss objective (0.9 NA). The picture is shown with the 532 nm filter.

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Figure S6. IL-6/PBS drop coat in rGO/Si. The spectra were taken in the region of "coffee ring". The picture was taken with a CCD camera coupled to the optical microscope of WITec Alpha 300 Series Raman-AFM, using the 10X Zeiss objective (0.2 NA). The picture is shown with the 532 nm filter.

## References

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