Supporting Information

A strategy towards melanin-based functional material: rGO and sulfonated melanin composites

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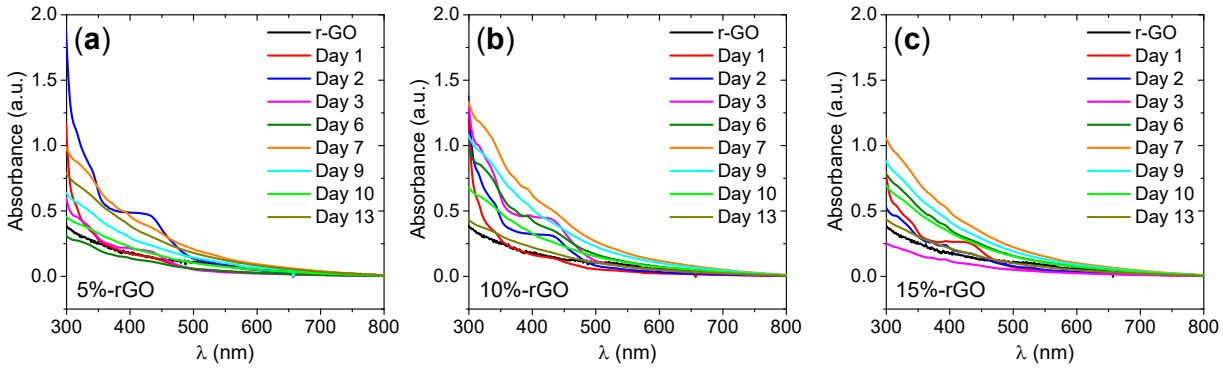

Figure S1: Evolution of the absorbance spectra of the composite's synthesis. With time the 450 nm absorption band decrease (indicating that the melanin precursor is being consumed) and a broad-band featureless spectrum characteristic of melanin appears.

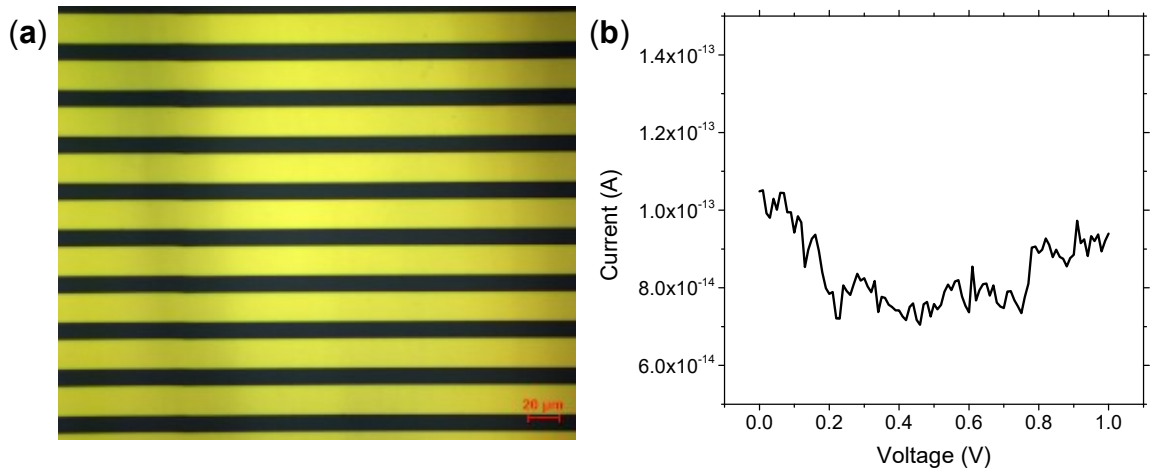

Figure S2: (a) Optical image of IDE electrode and (b) interdigitated electrode leakage current.

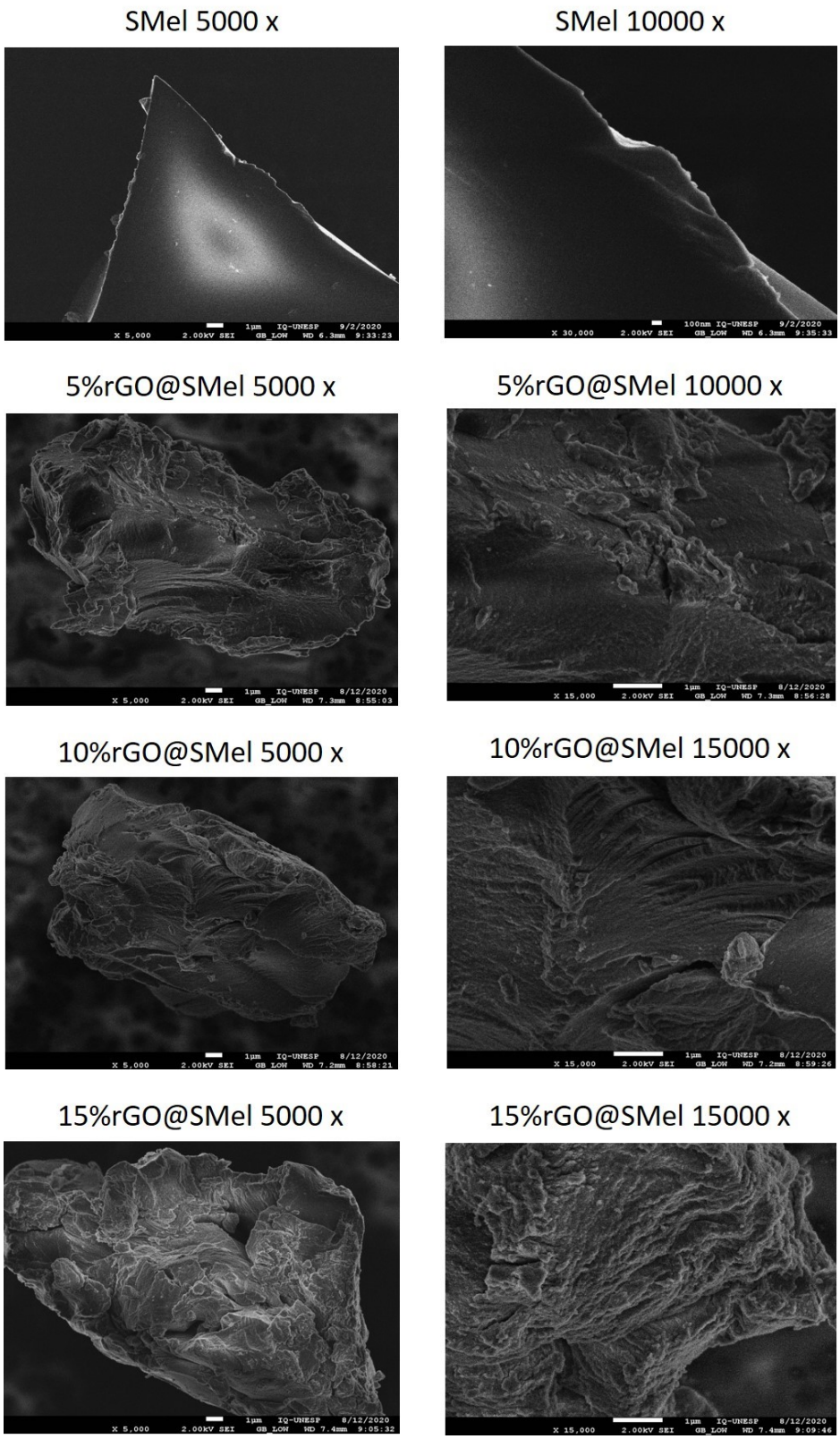

Figure S3: FEG-SEM images with different magnifications for the samples SMel and rGO@SMel composites.

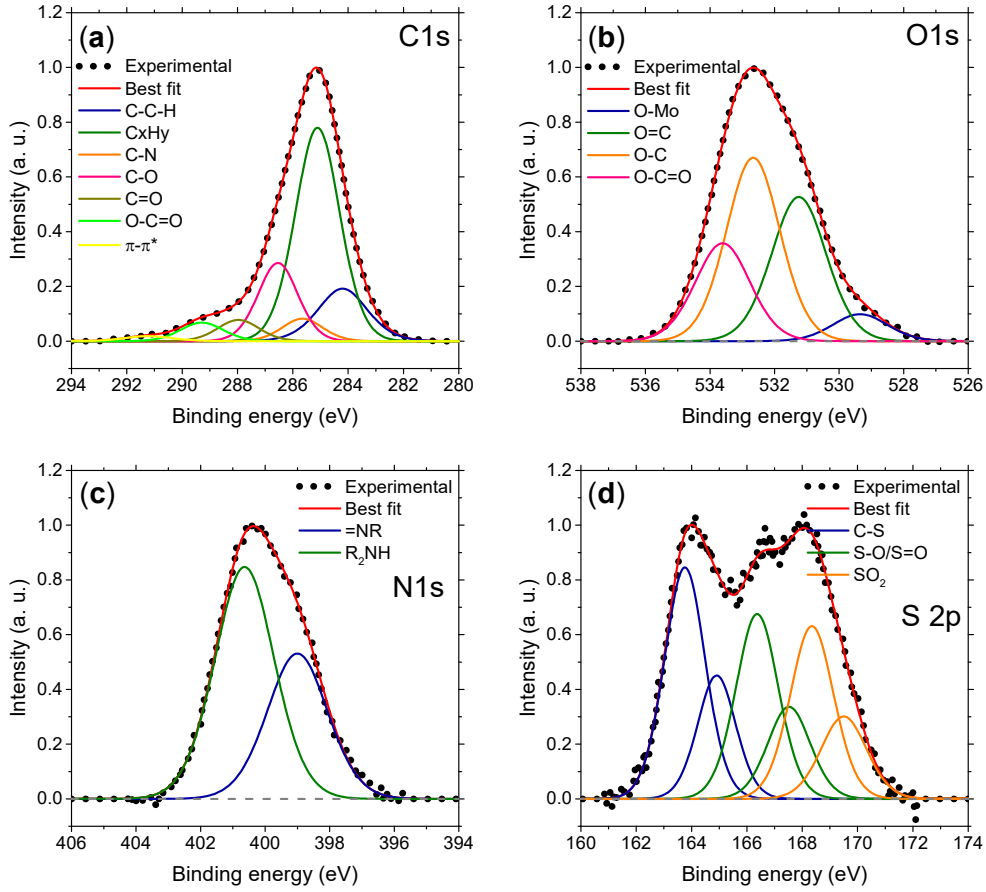

Figure S4: (a) C1s, (b) O1s, (c) N1s and (d) S 2p high-resolution XPS spectra of the SMel. O-Mo at O1s region is related to sample support.

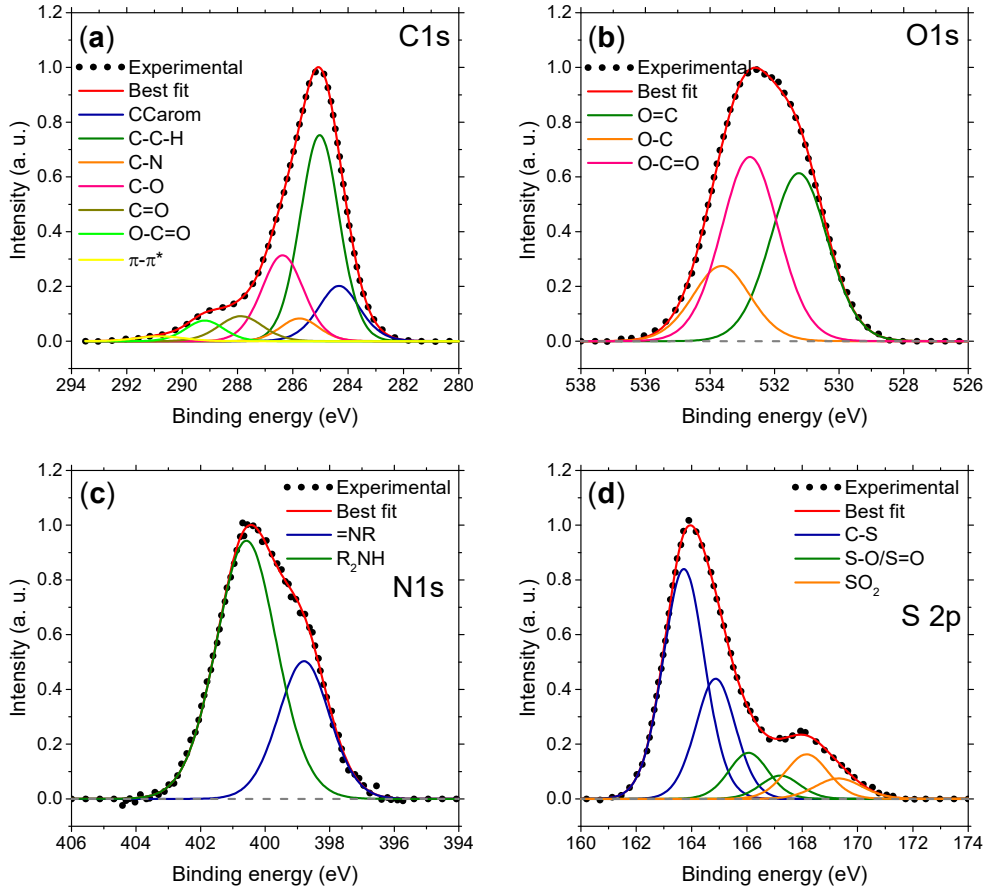

Figure S5: (a) C1s, (b) O1s, (c) N1s and d) S high-resolution XPS spectra of the 5%rGO@SMel.

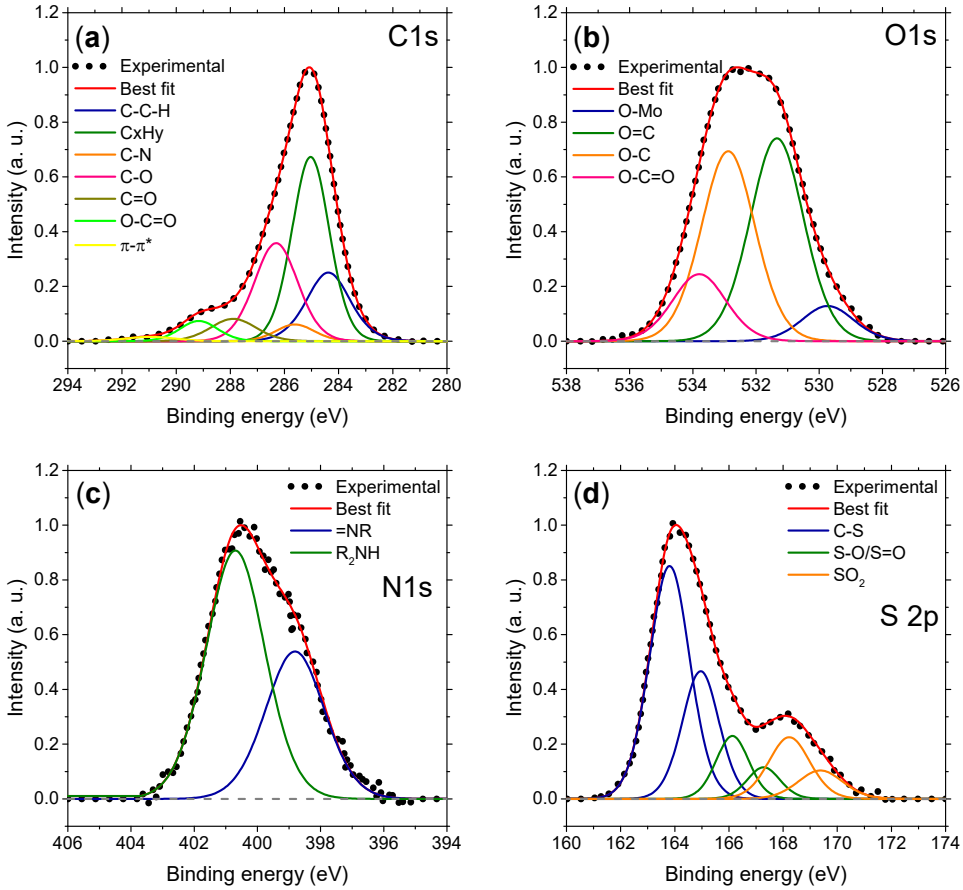

Figure S6: (a) C1s, (b) O1s, (c) N1s and (d) S 2p high-resolution XPS spectra of the 15%rGO@SMel. O-Mo at O1s region is related to sample support.

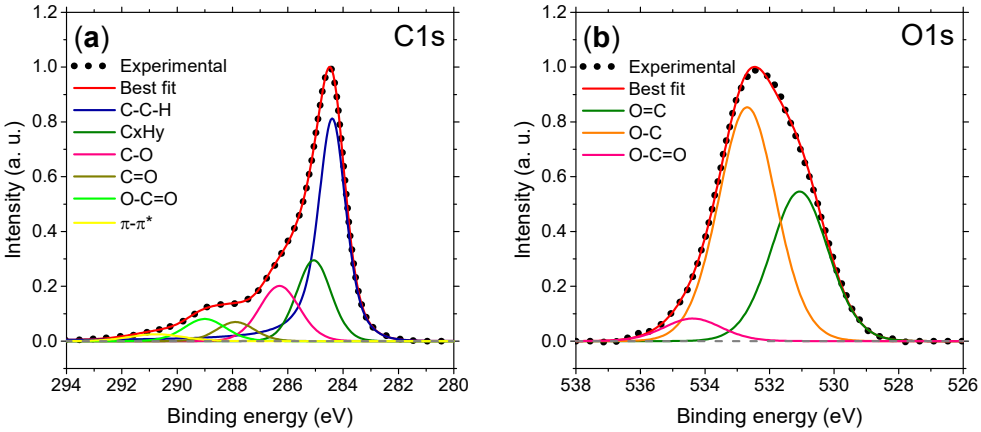

Figure S7: (a) C1s and (b) O1s high-resolution XPS spectra of rGO.

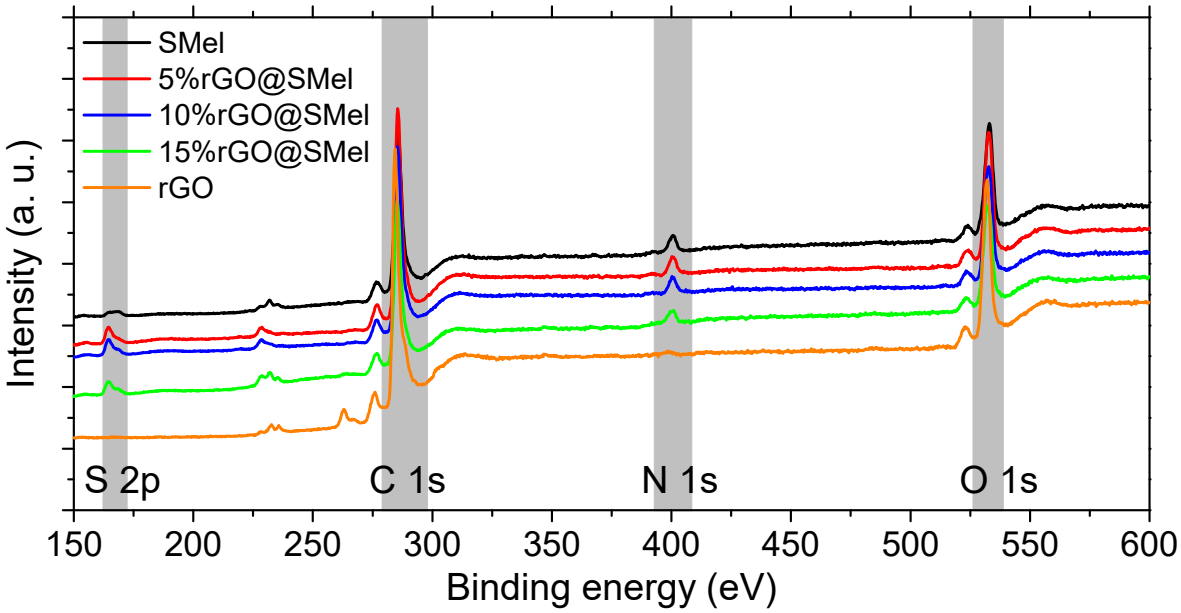

Figure S8: XPS Survey scan for the different samples studied.

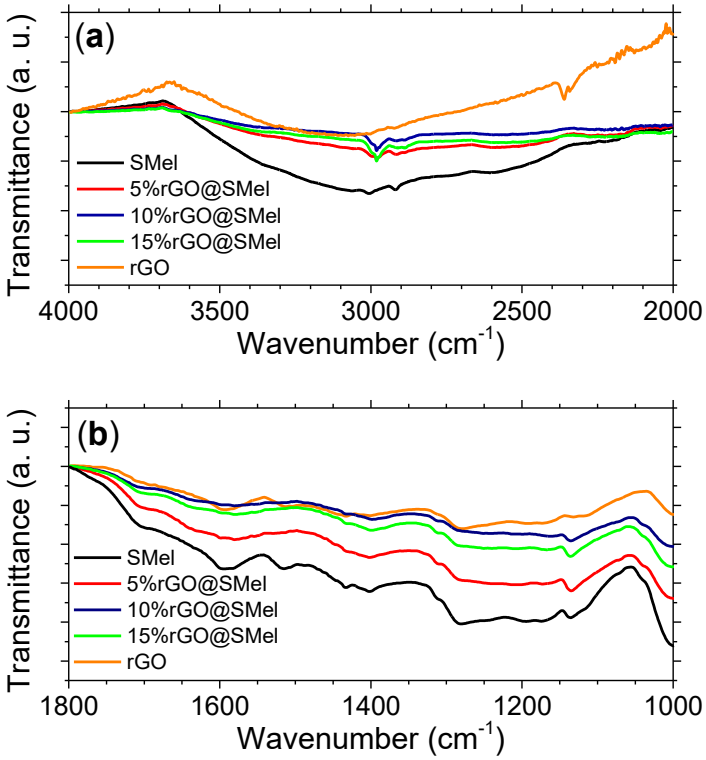

Figure S9: FTIR spectra of SMel, 5%SMel@rGO, 10%SMel@rGO and 15%SMel@rGO.

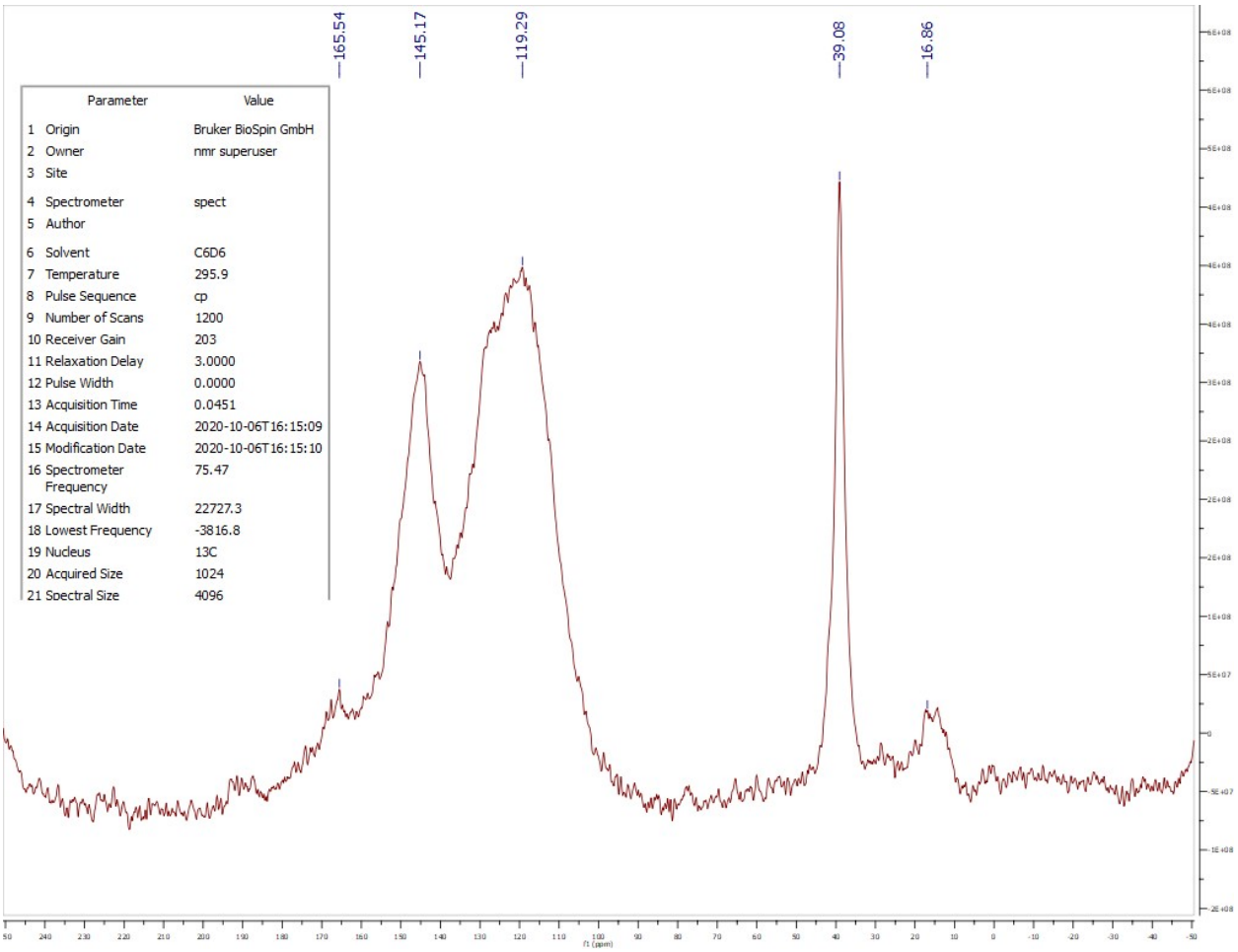

Figure S10: ^{13}C CP/MAS NMR spectra of SMel.

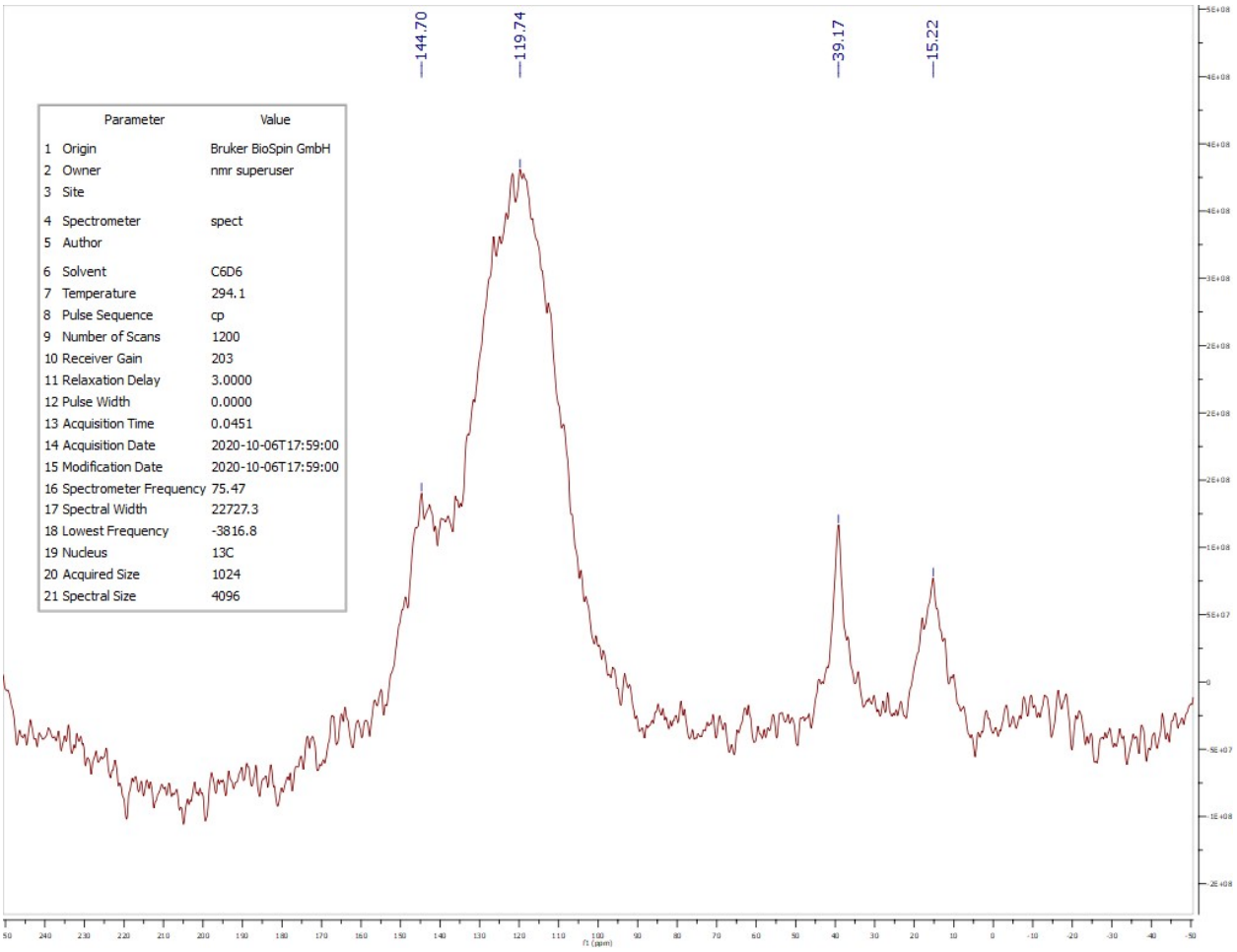

Figure S11: ^{13}C CP/MAS NMR spectra of 5%rGO@SMel.

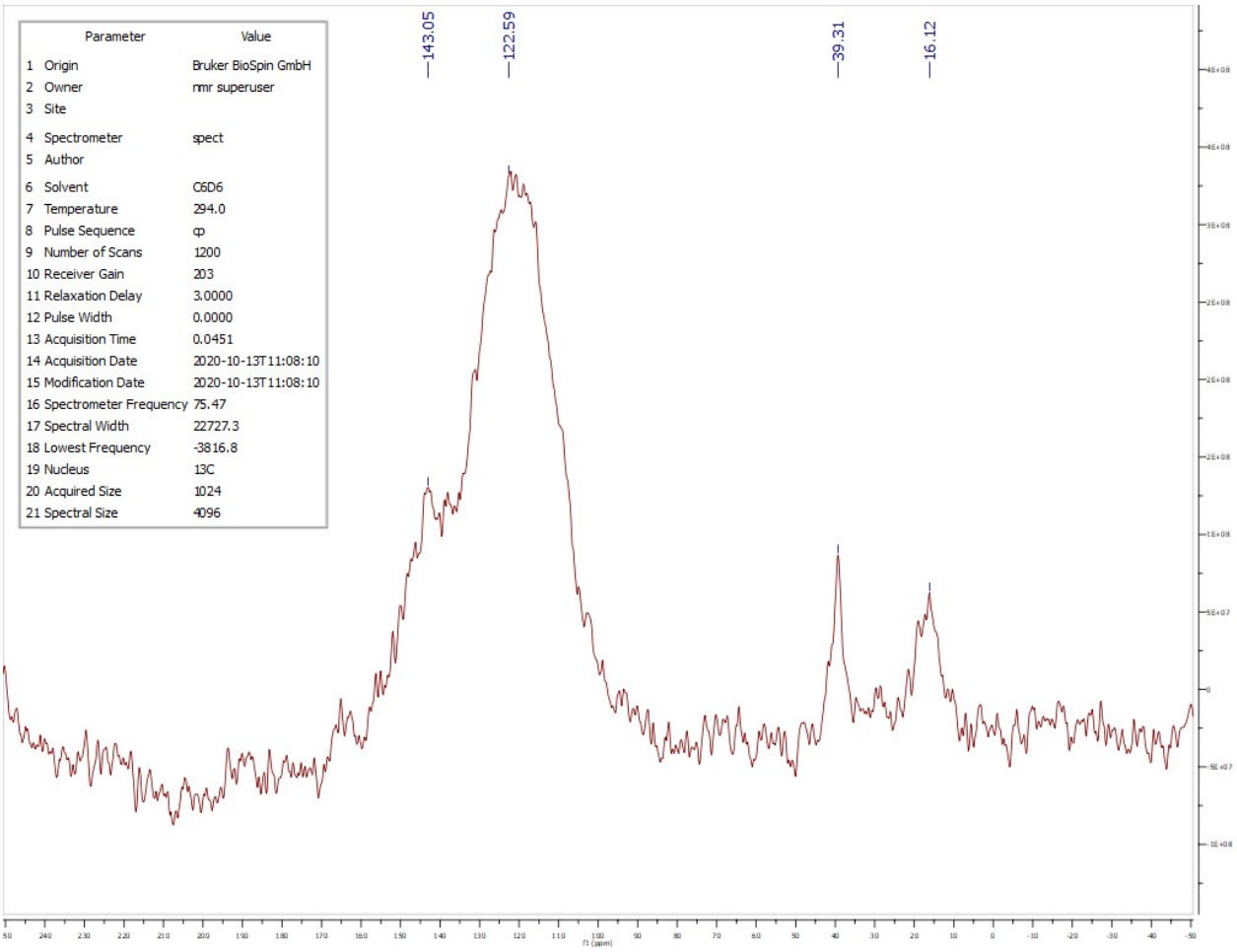

Figure S12: ^{13}C CP/MAS NMR spectra of 10%rGO@SMel.

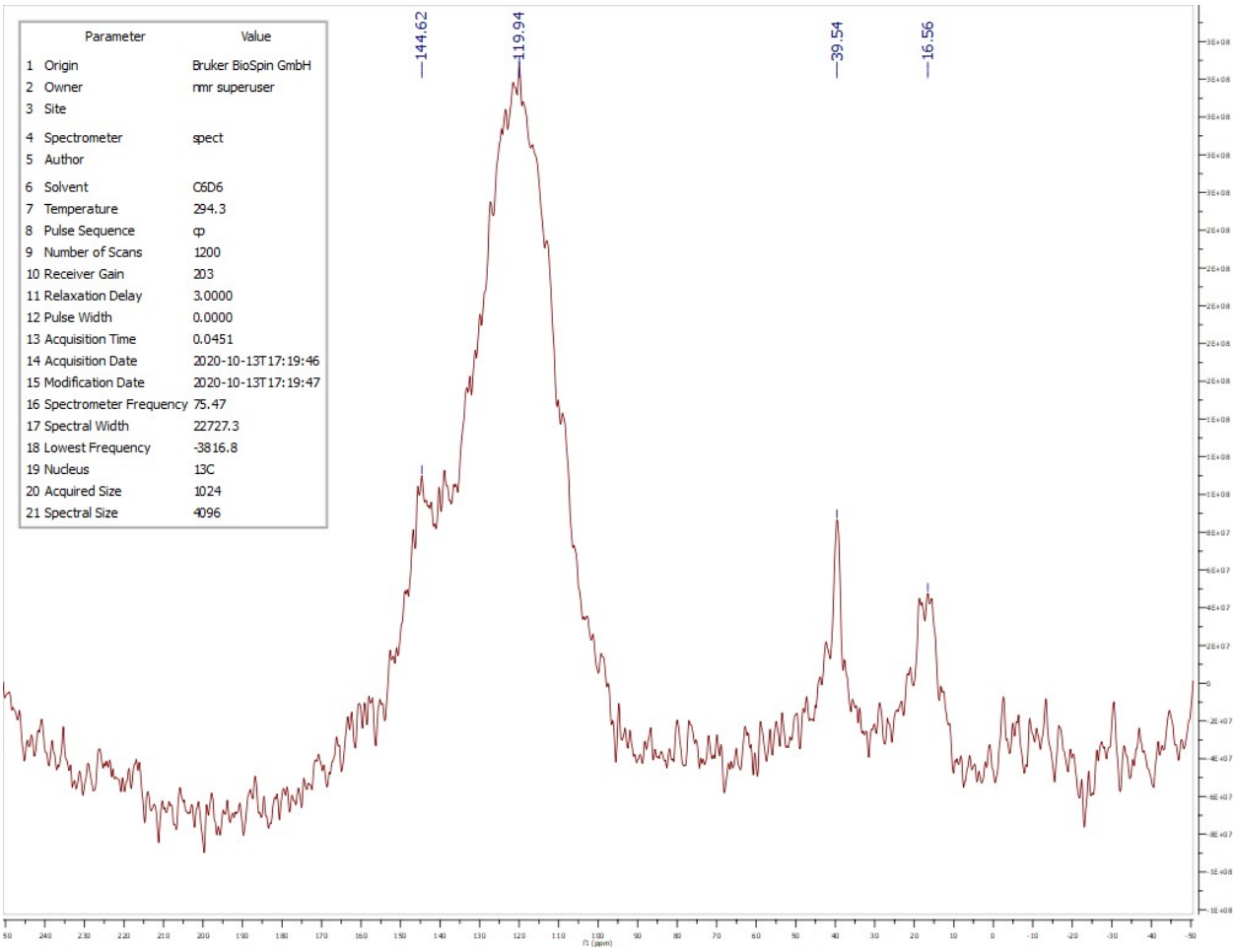

Figure S13: ^{13}C CP/MAS NMR spectra of 15%rGO@SMel.

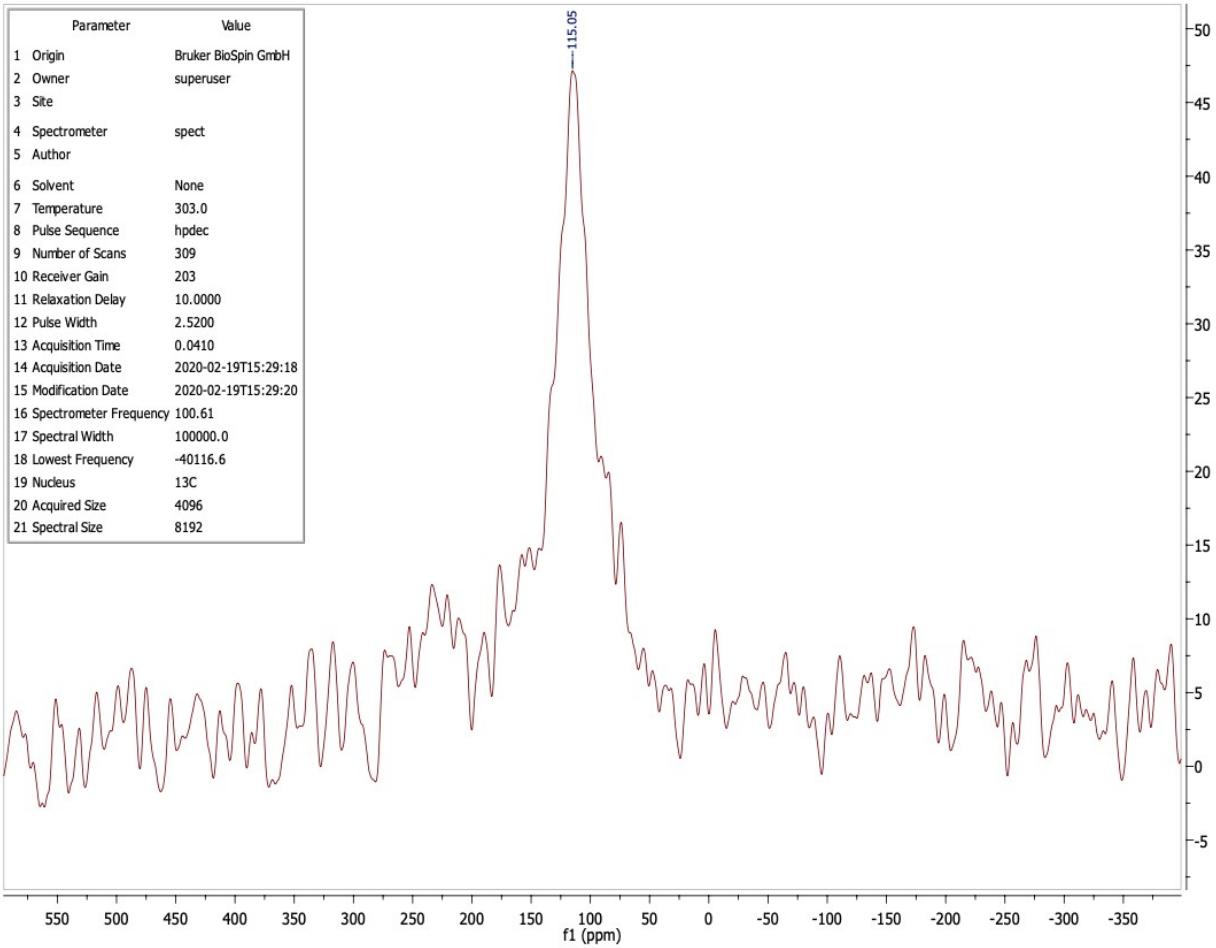

Figure S14: ^{13}C CP/MAS NMR spectra of rGO.

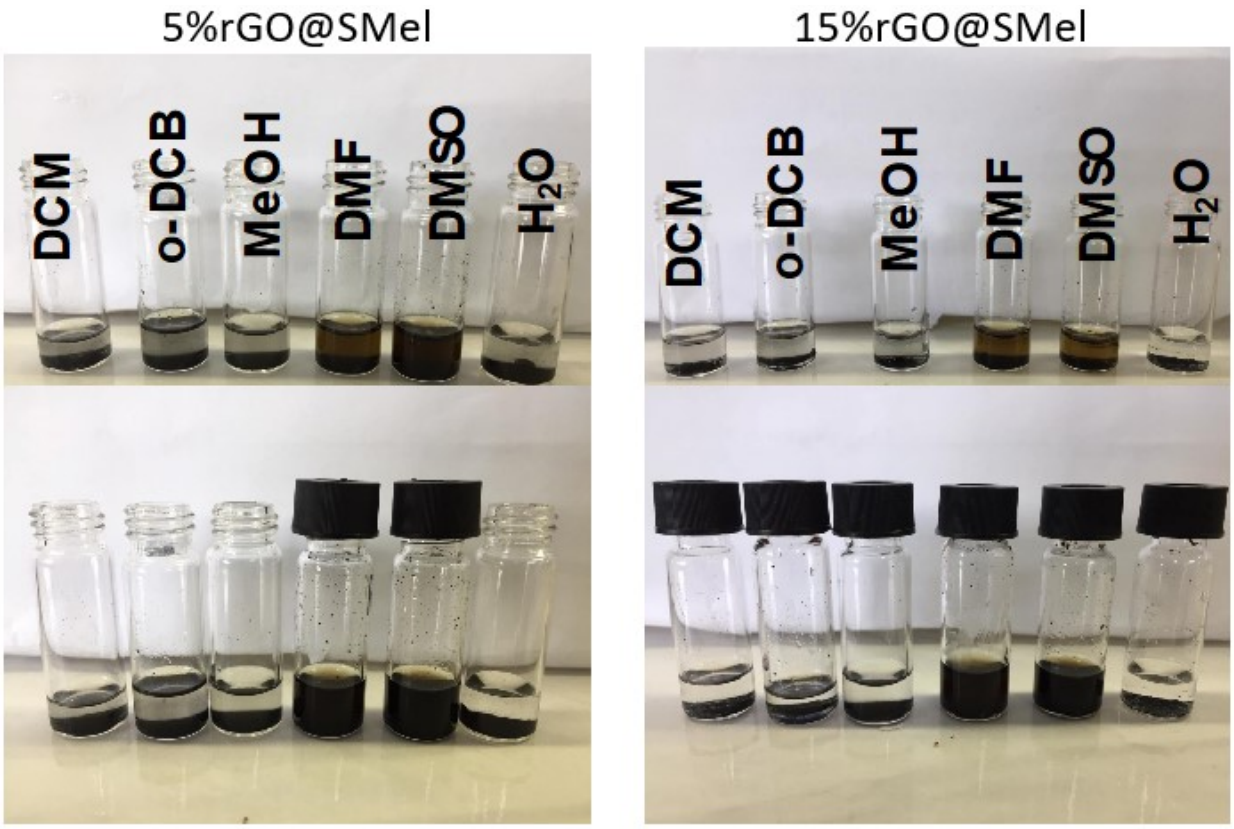

Figure S15: Solubility test of the composites 5%rGO@SMel and 15%rGO@SMel in dichloromethane, o-dichlorobenzene, methanol, dimethylformamide, dimethyl sulfoxide and water.

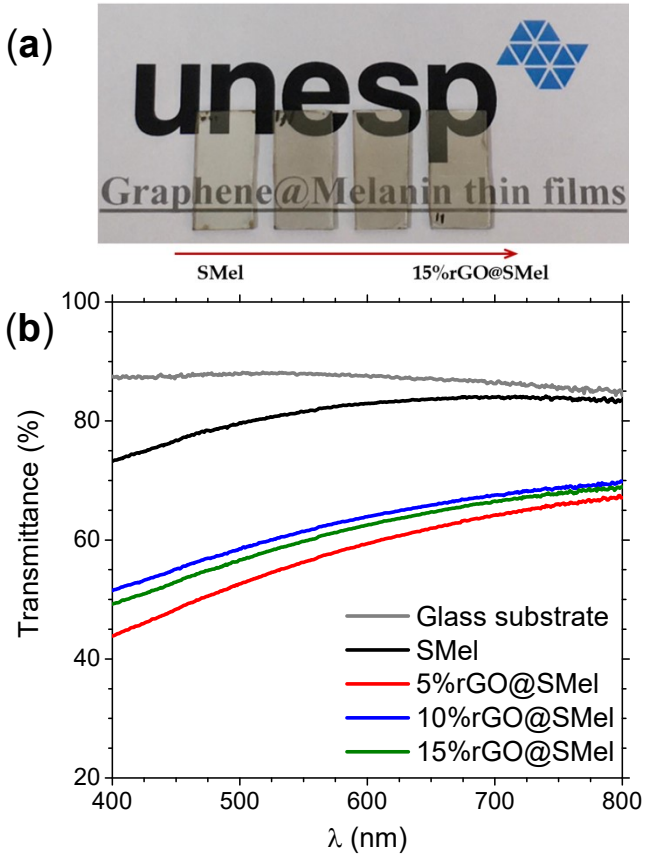

Figure S16: (a) Optical image and (b) transmittance spectra of SMel and rGO@SMel composites thin films.

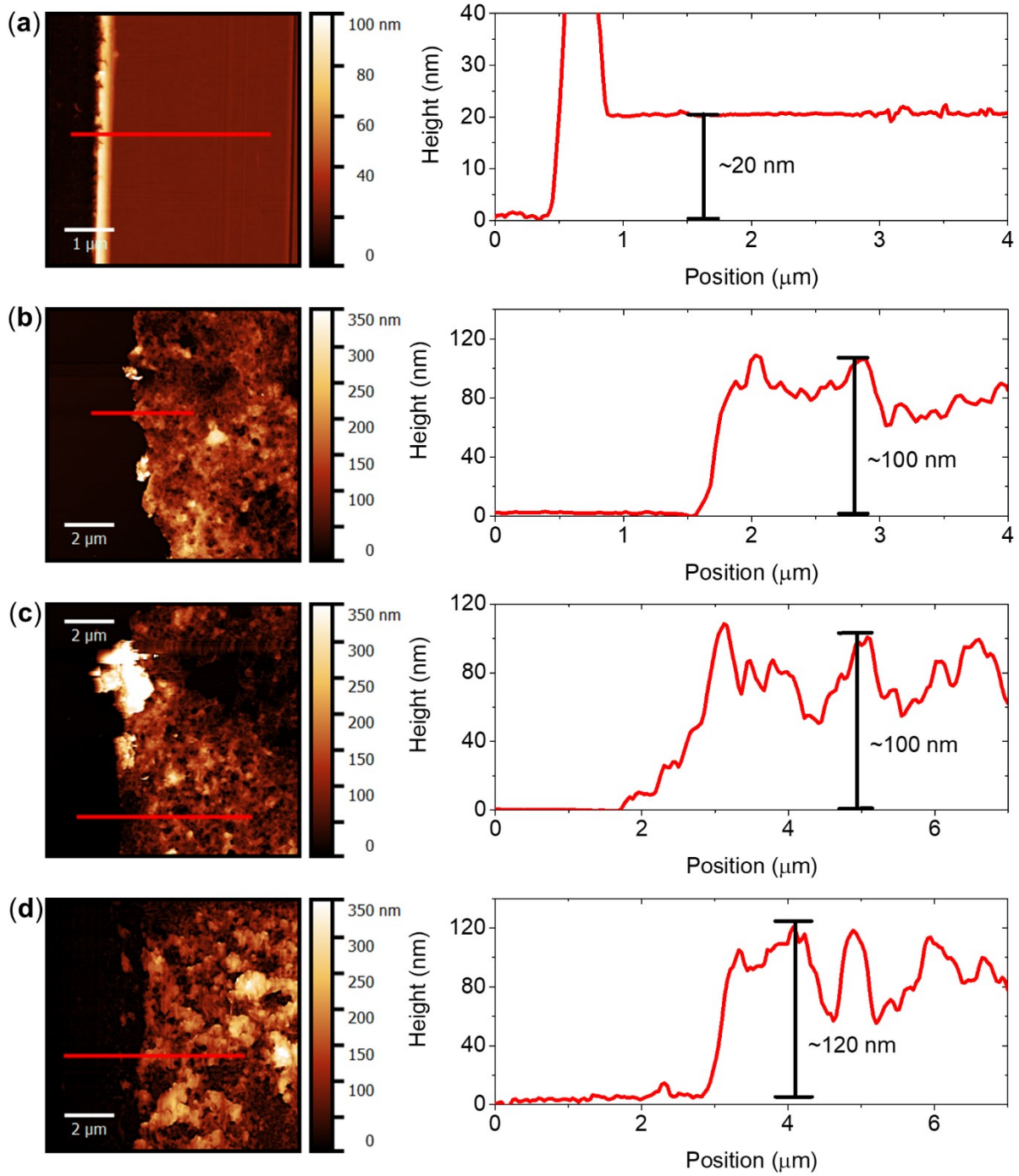

Figure S17: AFM topography images and thickness profiles (red lines): (a) SMel, (b) 5%rGO@SMel, (c) 10%rGO@SMel and (d) 15%rGO@SMel.

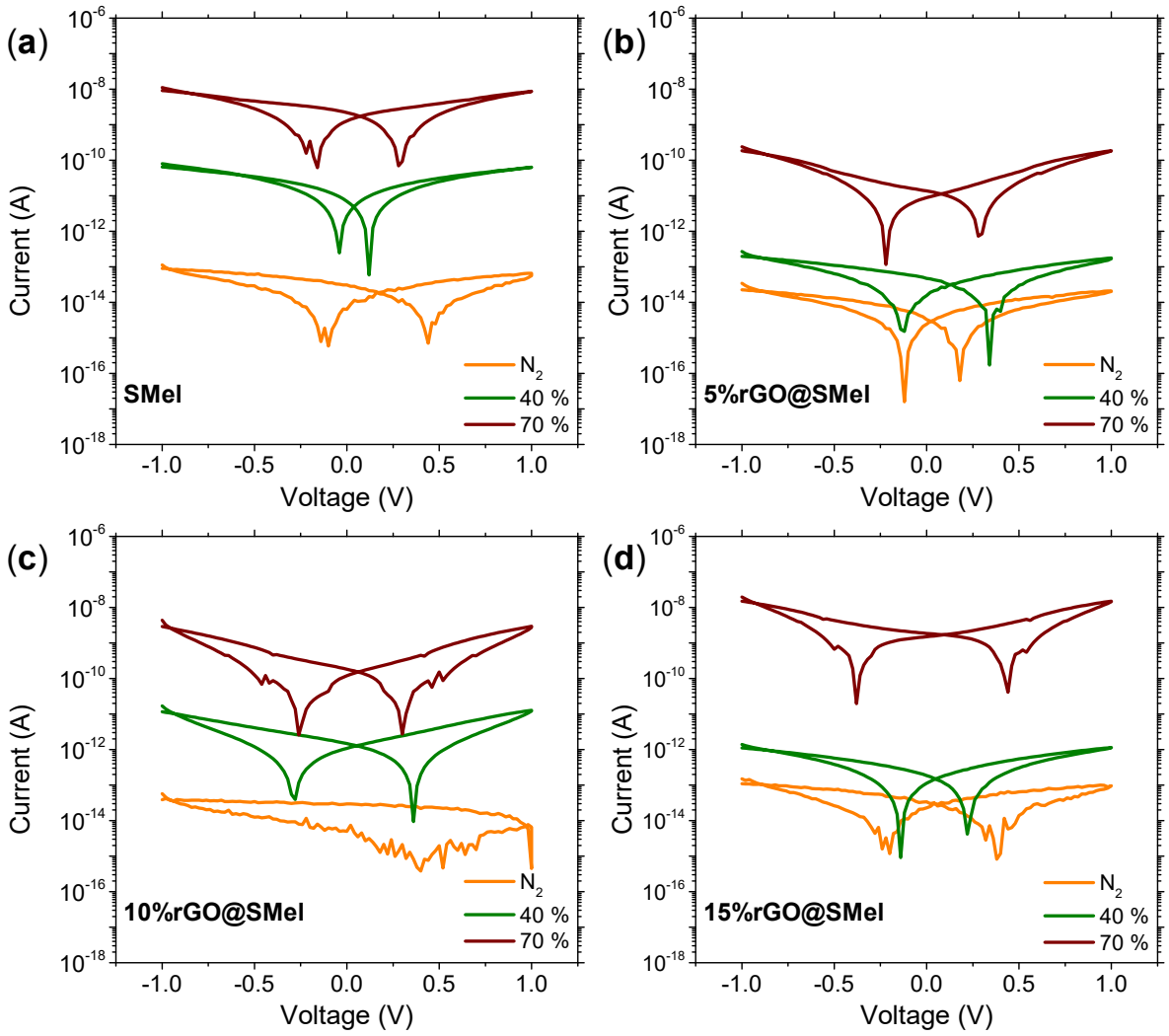

Figure S18: Current vs. voltage characteristics of (a) SMel and (b, c and d) rGO@SMel composites in different humidity levels: N_2, 40 % and 70 % RH. The IV curves were plotted on a log-linear scale to show the humidity dependence of the different rGO@SMel composites.

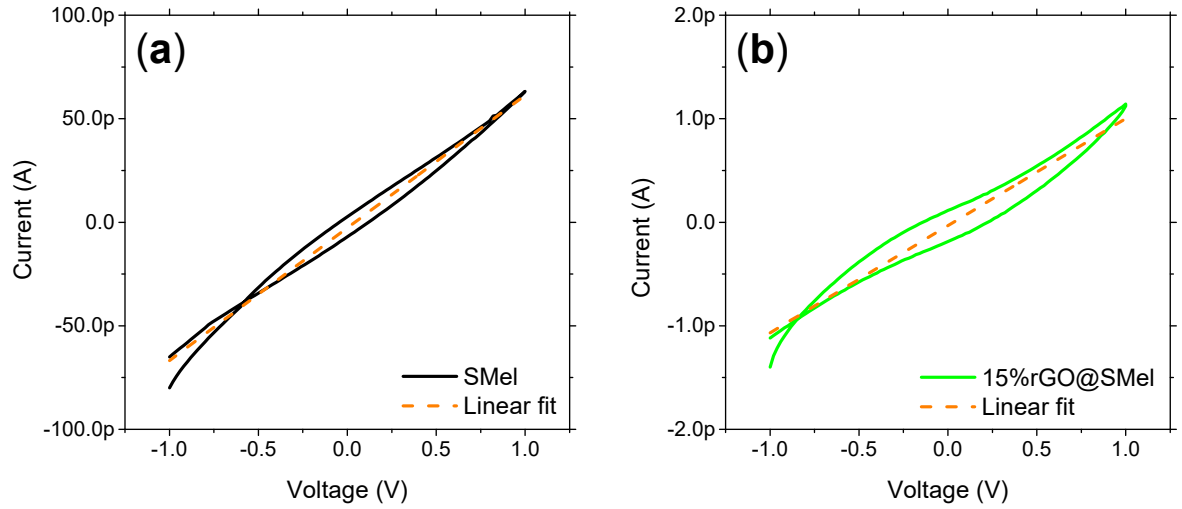

Figure S19: Example of fitting used to calculate the conductivity at 40% RH for (a) SMel and (b) 15%rGO@SMel composite. Similar behavior was obtained for the other samples and RH.

Table S1: Fitting parameters used to fit the data according to the equivalent circuit at 70% hydration level. The Warburg diffusion element is divided in three components: W-R represents the diffusion impedance, W-T is the system diffusion time and W-P is an exponential factor.

Sample	SMel	5%rGO@SMel	10%rGO@SMel	15%rGO@SMel
R_1	1.74E+02	1.77E+02	1.87E+02	2.12E+02
R_2	4.15E+08	4.90E+8	1.66E+07	3.02E+05
W-R	9.14E+07	9.13E+07	8.22E+07	3.36E+08
W-T	4.30E-03	8.06E-11	1.59E-04	5.21E+03
W-P	1.90E-01	0.62E-01	1.13E+00	4.06E-01
CPE-T	1.16E-10	1.18E-10	1.13E-10	1.20E-10
CPE-P (η)	0.99545	0.99477	0.99762	0.99587

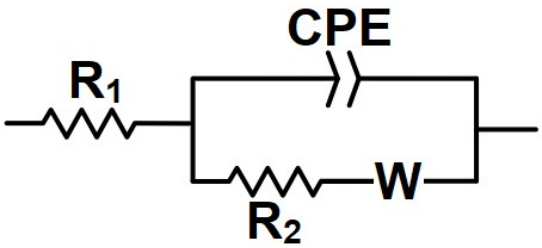

Figure S20: Representation of the equivalent circuit for the composite's characterization in between gold electrodes.