Supporting Information

Multifunctional electrocatalytic hybrid carbon nanocables with highly active edges on their walls

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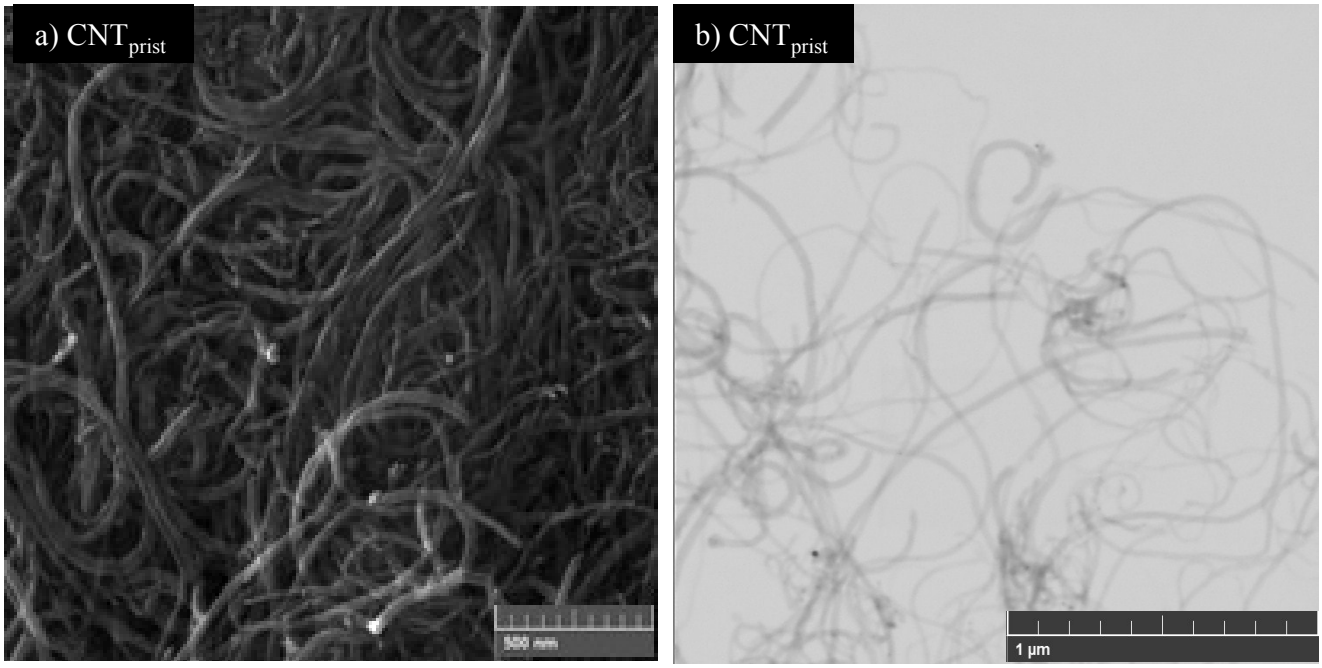

Fig. S1 SEM (a) and STEM (b) of starting material CNT_{prist}.

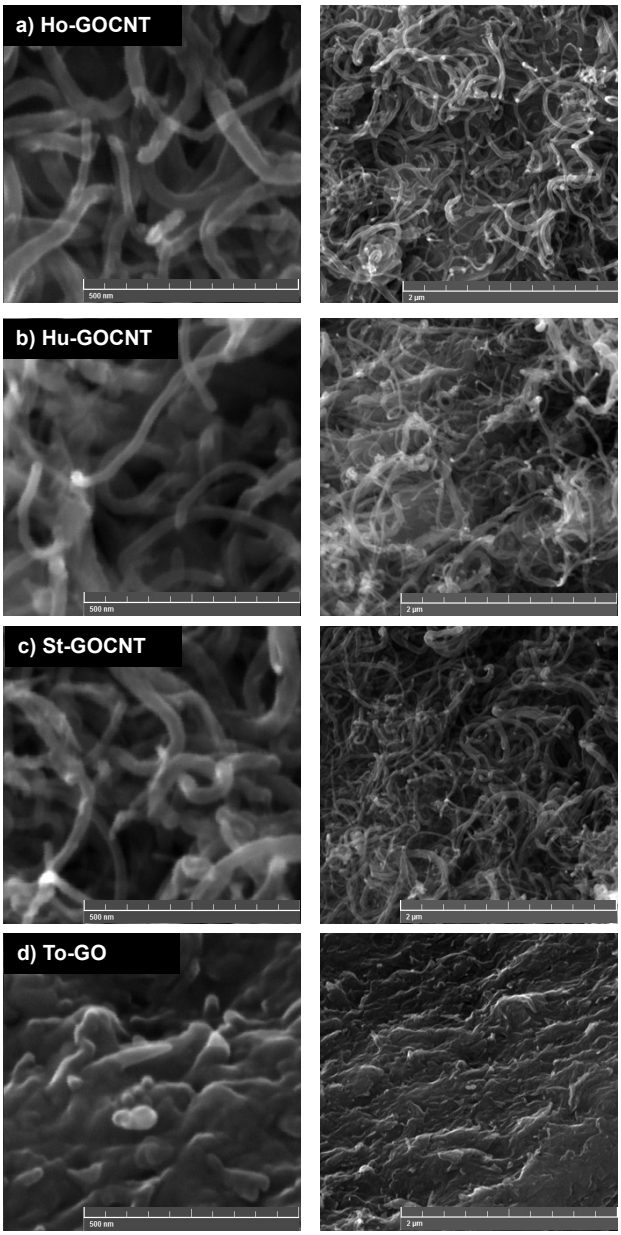

Fig. S2 Scanning electron micrographs of GOCNT resulting from oxidative opening of CNT prepared by Hofmann (Ho-GOCNT), Hummers (Hu-GOCNT), Staudenmaier (St-GOCNT) and Tour (To-GO, d) methods at different magnifications.

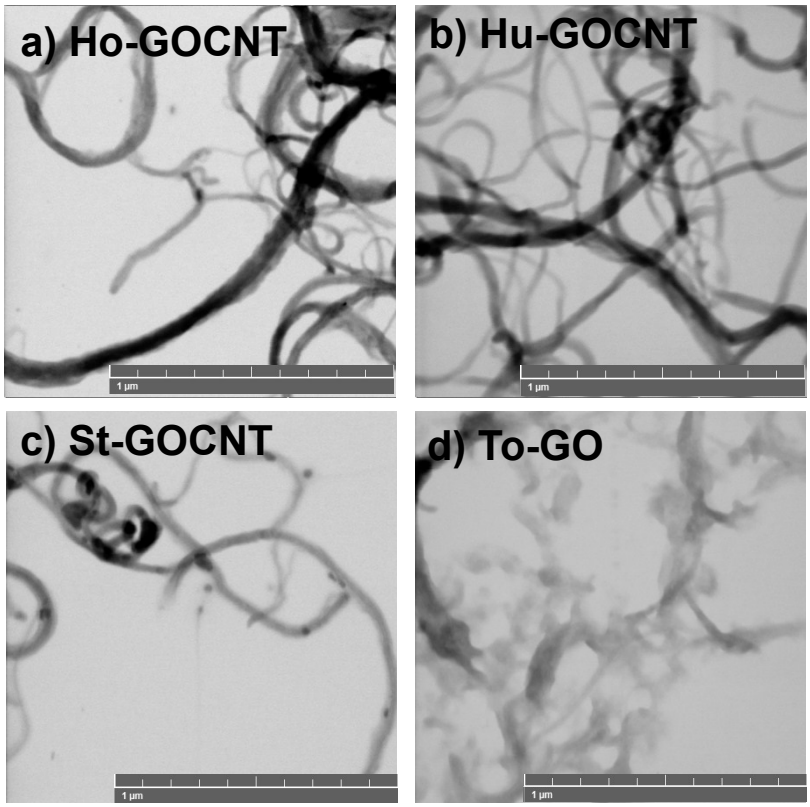

Fig. S3 Scanning transmission electron micrographs (STEM) of GOCNT resulting from oxidative opening of CNT prepared by Hofmann (Ho-GOCNT), Hummers (Hu-GOCNT), Staudenmaier (St-GOCNT) and Tour (To-GO, d) methods at 100K magnifications.

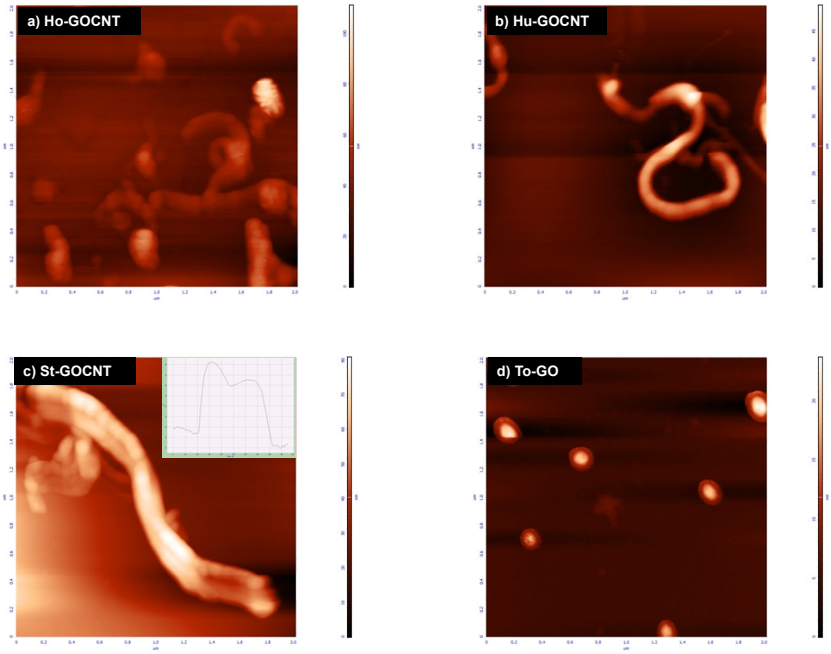

Fig. S4 AFM images of GOCNT resulting from oxidative opening of CNT prepared by Hofmann (Ho-GOCNT), Hummers (Hu-GOCNT), Staudenmaier (St-GOCNT) and Tour (To-GO, d) methods at different magnifications.

Vibration bands-FT IR spectra Fig. S5 shows the Fourier transform infrared spectra (FTIR) of the differently obtained GOCNT nanocables. The hydroxyl groups stretching and bending form broad absorption band in the range of 3000–3500 cm^{-1}. Carbonyl group stretching vibration in carboxylic acids forms absorption band at 1700 cm^{-1}. C=C stretching vibration in the sp^2 hybridized carbon atoms form absorption band around 1550-1600 cm^{-1}. Carbonyl groups stretching vibrations form broad absorption band in the range of 1370–1450 cm^{-1}. C-O stretching vibration of hydroxyl groups for broad absorption band in the range of 1150–1250 cm^{-1}. C-O-C stretching and binding vibration in epoxide groups form absorption band in the range of 900–1000 cm^{-1}. An abundance of oxygen-containing functional groups formed by the oxidation on the surface of CNT is verified making the GOCNT surface more hydrophilic. From Fig. S5, To-GO seems to have more intense and better resolved peaks, although for a more accurate quantification of oxygen groups XPS analysis should be done.

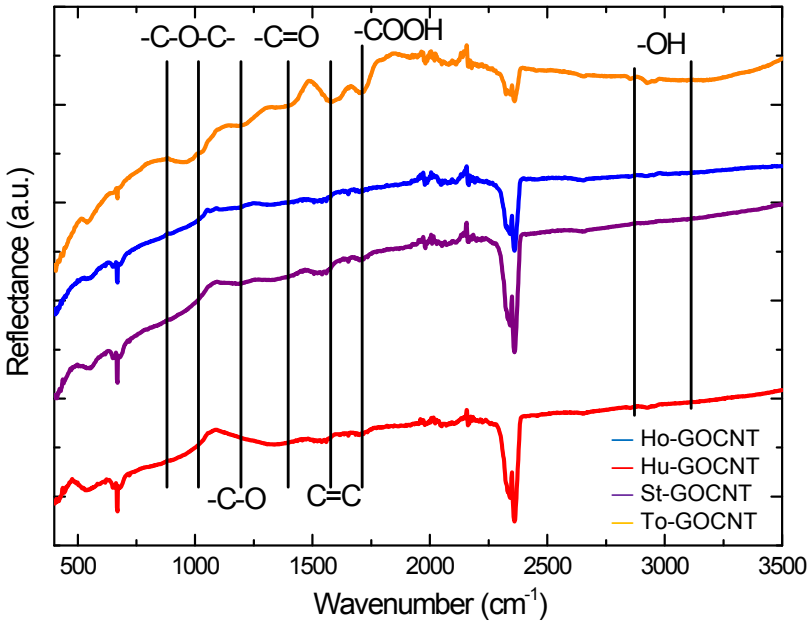

Fig. S5 FTIR specta the different hybrid GOCNT nanomaterials.

Table S1 - C/O ratio obtained from XPS survey scans by elemental analysis using respective atomic percentages of C1s, O1s, S 2p, Cl 2p and F 1s peaks.

	CNT_{prist}	Ho GOCNT	Hu GOCNT	St GOCNT	To GO
C 1s	97.7	74.2	76.8	73.8	68.5
O 1s	2.7	25.2	23.2	23.2	29.0
S 2p	-	-	-	-	0.6
Cl 2p	-	0.5	-	-	-
F 1s	-	-	-	-	1.9

Table S2. Quantitative comparison of X-ray photoelectron spectra of the C 1s core level for CNT_{prist} and the differently obtained GOCNT.

	CNT_{prist}	Ho-GOCNT	Hu-GOCNT	St-GOCNT	To-GO
C-C	71.3	38.2	35.2	20.0	20.5
C=C	10.1	11.7	23.0	17.0	26.8
C-O	7.8	**35.7**	21.0	**30.2**	6.5
C=O	3.2	6.0	11.5	13.3	**33.7**
O-C=O	3.8	4.3	6.4	**13.4**	10.3
$\pi - \pi^*$	4.3	4.1	2.9	6.1	2.1

Table S3 - Elemental combustion analysis

Sample	CNT_{prist}	Ho-GOCNT	Hu-GOCNT	St-GOCNT	To-GO
At. %C	98.01	57.14	60.19	54.93	40.28
At. %H	0	19.66	19.15	20.79	28.78
At. % N	0.07	0.18	0.18	0.18	0.35
At. %O	1.92	23.03	20.48	24.11	30.6

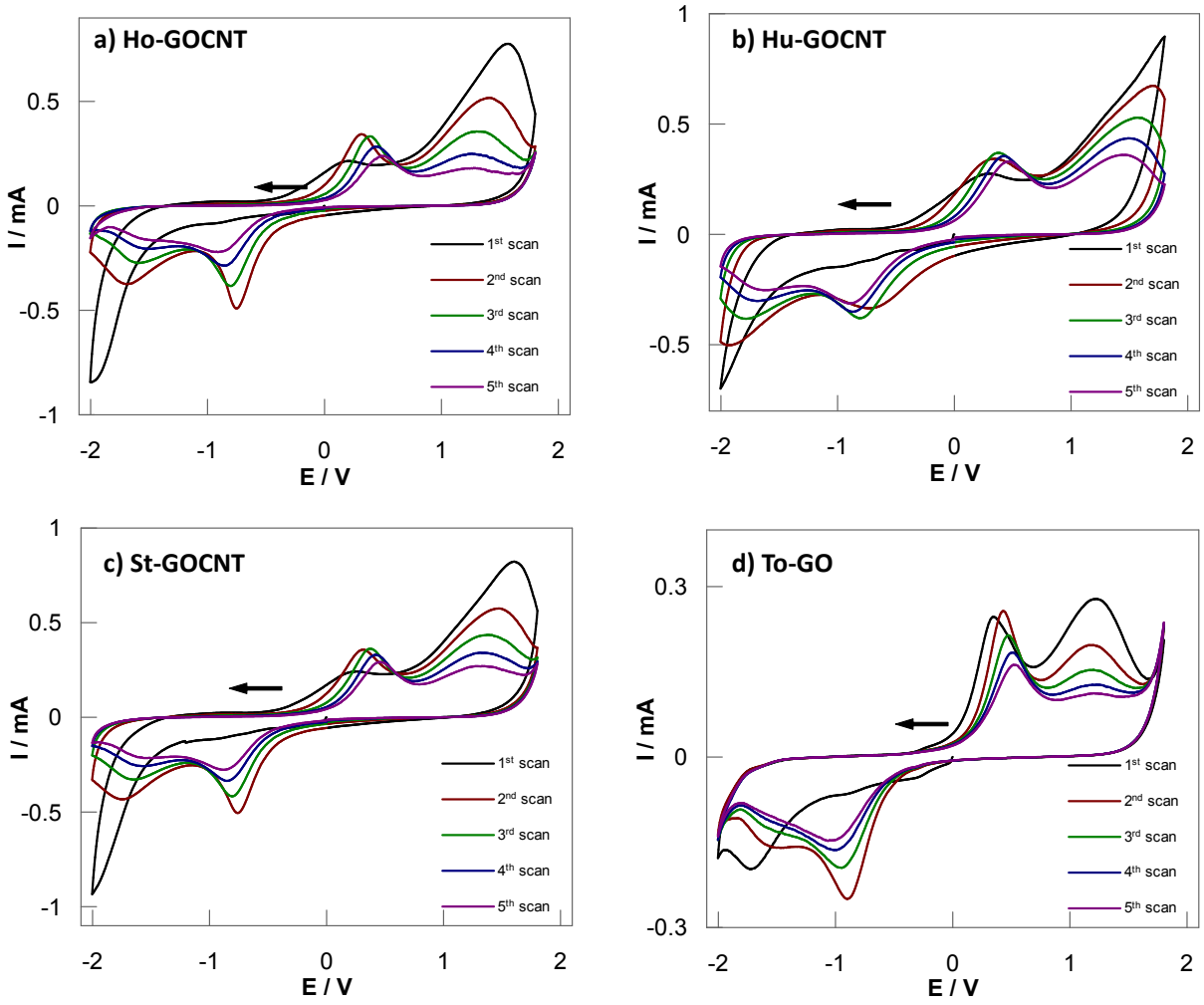

Fig. S6. CVs of GOCNT prepared through the methods of a) Hummers, b) Hofmann, c) Staudenmaier, d) Tour. Arrows indicate the directions of the first scans (towards reducing potentials). All starting potentials are 0.0 V and are relative to the Ag/AgCl reference electrode. Supporting electrolyte: 0.1 M PBS at pH 7.2; scan rate: 100 mV/s.

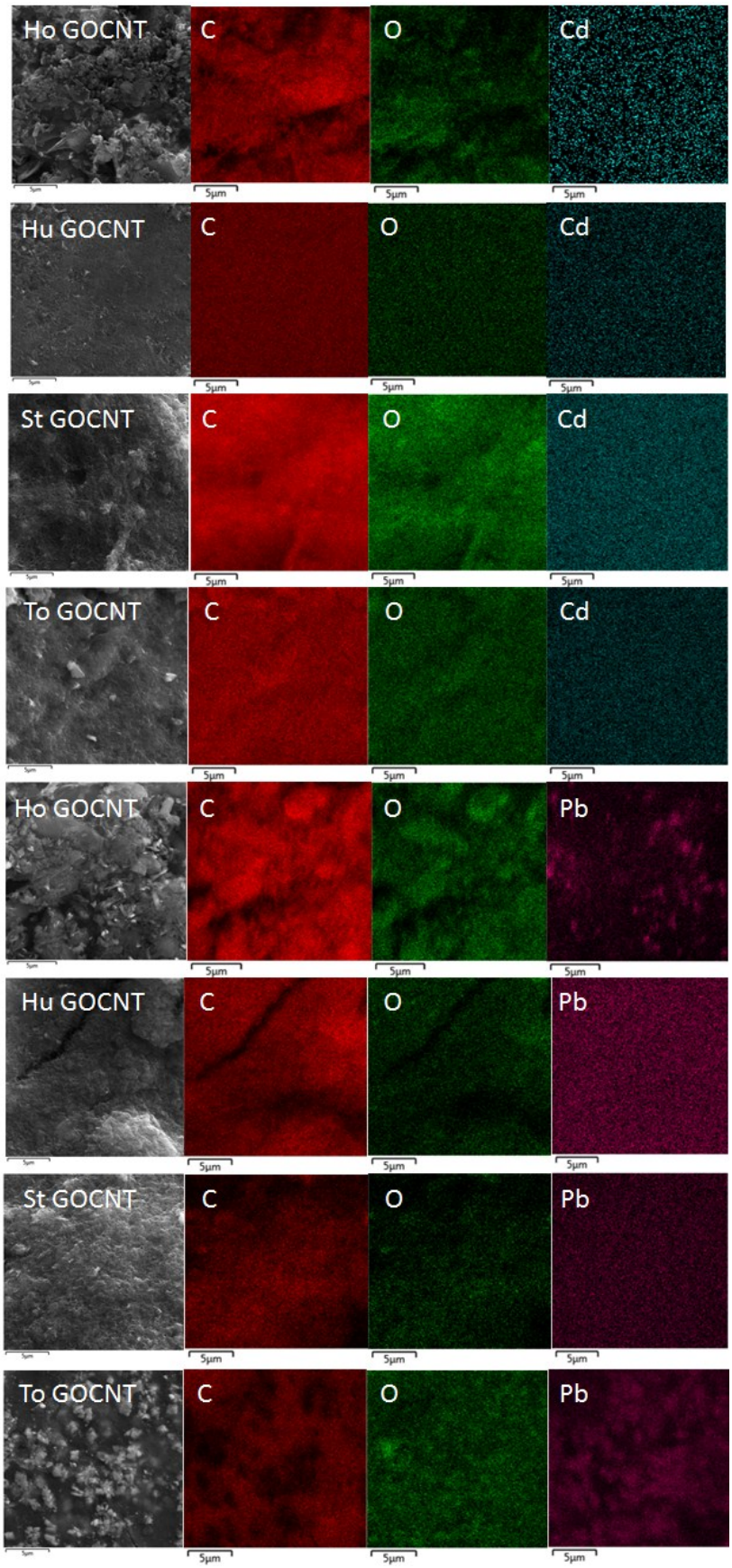

Fig. S7. Elemental maps of nanocables after sorption of cadmium and lead.