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Supporting Information

for

Interconnection morphology effects on the radio frequency response of carbon nanotube sponges

Manuela Scarselli, Javad Rezvani, Zeno Zuccari, Mattia Scagliotti and Simone Tocci

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Additional details on CNS preparation, XPS analysis, and antenna characterization

Synthesis of the carbon nanotube films and the 3D assembly

Figure S1 reports a SEM micrograph of the CNT film grown on the silicon substrate. In the inset is a magnified area of the film.

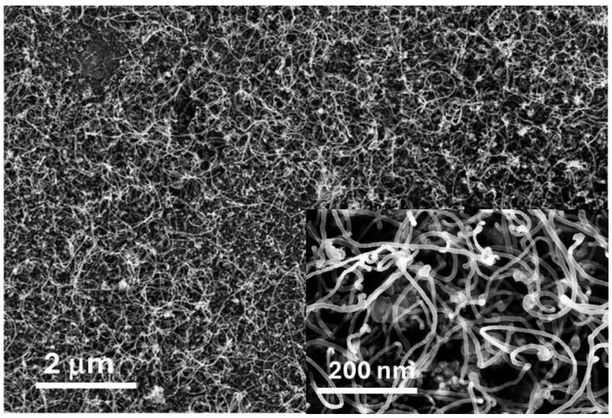

Figure S1: SEM micrograph of the CNT film grown on a silicon substrate.

Table S1 summarizes the parameters adopted for the synthesis of the studied CNT samples.

Table S1: CNT synthesis parameters: growth temperature (°C), gas partial pressure (sccm), and growth time (h).

Sample	Growth temp. [°C]	C_2H_2 [sccm]	H_2 [sccm]	Ar [sccm]	Growth time [h]
CNT film on Si	750	20	20	50	0.5
CNT sponge	750	80	100	200	2

XPS measurements

Figure S2 reports an XPS survey spectrum obtained from the CNS sample before and after ethanol treatment, where the C 1s and O 1s core levels are highlighted. The ratios between the C 1s and O 1s signals in each spectrum are reported in the image; it can be observed that, after ethanol treatment, the ratio decreases due to an increase in oxygen content. Table 2 reports a summary of the functional group content obtained from the C 1s and O 1s core level fits of Figure 5 in the main manuscript.

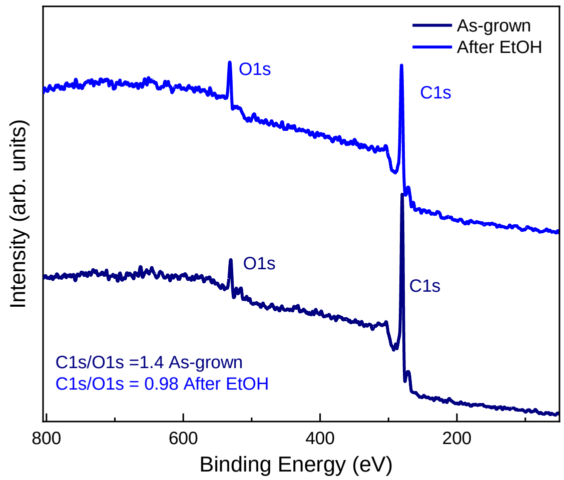

Figure S2: XPS survey spectra obtained on the as-grown CNS sample (dark blue line) and after ethanol treatment (light blue line).

Table S2: Functional group content obtained from the C 1s and O 1s core level fits.

	Sample	C–C (sp^2) [%]	C–OH [%]	C=O [%]	C=O (OH) [%]
C 1s	as-grown	54.0	30.3	15.7	0.0
C 1s	after EtOH	36.2	37.7	16.8	9.3
		C–O–H [%]	OH–C [%]	water [%]	
O 1s	as-grown	18.0	68.6	13.4	
O 1s	after EtOH	19.0	70.4	10.6	

Measurements on the CNT antennas

The setup used for the measurements includes an Agilent E5071C ENA vector network analyser and a coaxial cable (Figure S3). The Network analyser sends signals at frequencies between 300 kHz and 20 GHz and measures the reflected signal, generating an S_{11} curve. A coaxial cable is connected to the instrument, and the samples to be analysed are mounted on the hot pole of the latter.

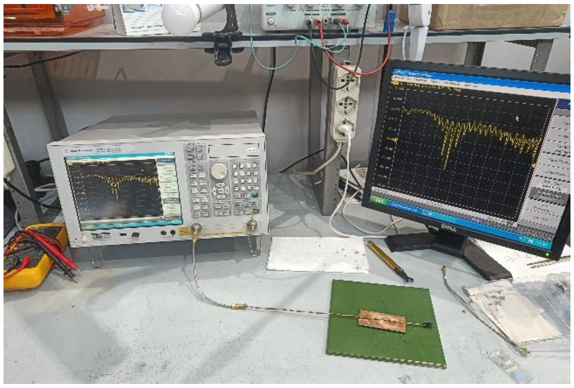

Figure S3: Experimental setup for the S_{11} measurement.

Figure S4 shows the schematic of the dipole antenna built for the measurement. The antenna is composed of two straight, aligned conductors separated by a small gap, one connected to the hot pole and the other to the ground of a coaxial cable. The antenna is powered at the centre, where an alternating signal generates an oscillating electric field along the arms, enabling long-distance communication.

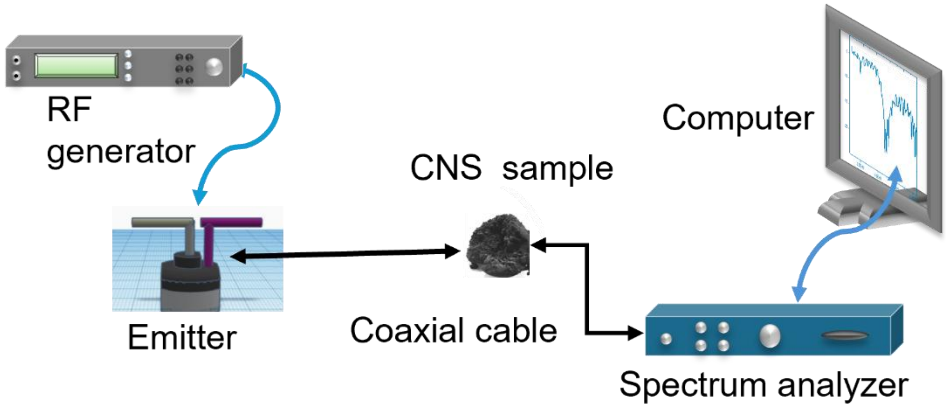

Figure S4: Schematics of the setup for the signal reception measurements.

Figure S5 shows a blow-up centred around the maximum value registered for the antenna at distances of (3.0 ± 0.1) × 10^{-1} m and (7.0 ± 0.1) × 10^{-1} m.

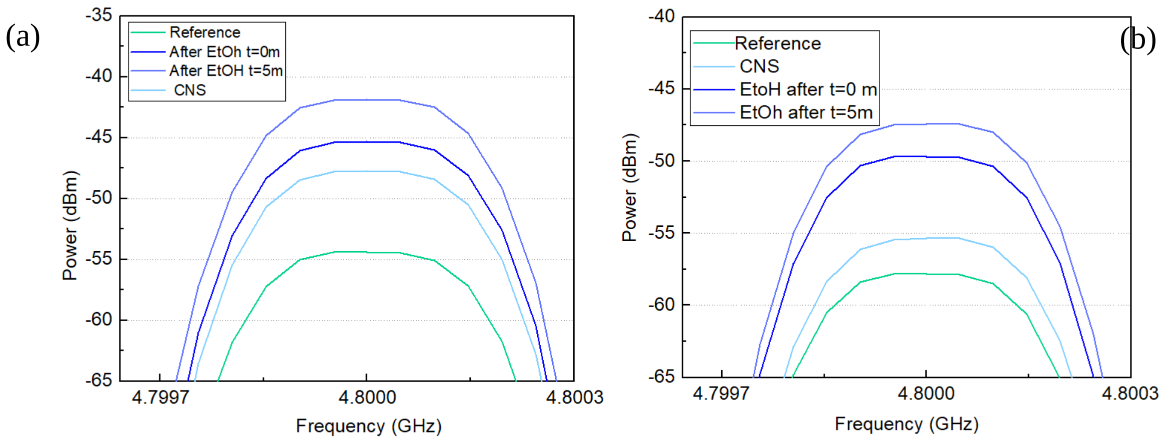

Figure S5: Enlarged view around the maximum value registered for the CNS antenna at distances of (a) (3.0 ± 0.1) × 10^{-1} m and (b) (7.0 ± 0.1) × 10^{-1} m.