Electronic Supplementary Material (ESI) for Nanoscale Advances.

Nanoimprinted Conducting Nanopillar Arrays Made of MWCNT/Polymer Nanocomposites: A Study by Electrochemical Impedance Spectroscopy

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Supporting Information

Table S-1. The pressure used for different MWCNT ratio

CNT ratio	Imprinting pressure (bar)
0%	0
5%	0.3
10%	0.5
20%	1
30%	2

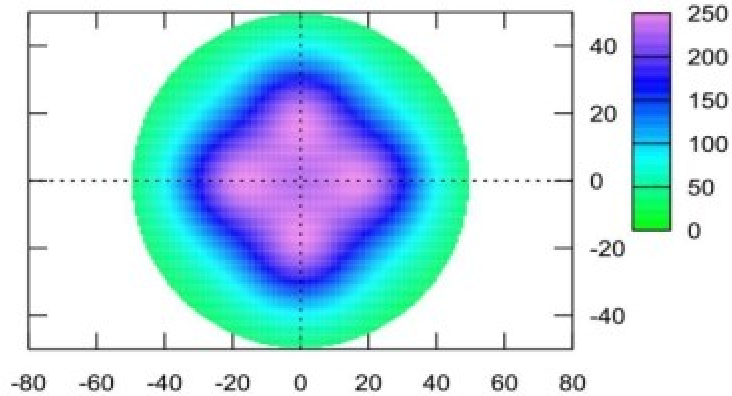

Figure S-1. The power distribution in mW/cm^2 of CNI from NIL technics.

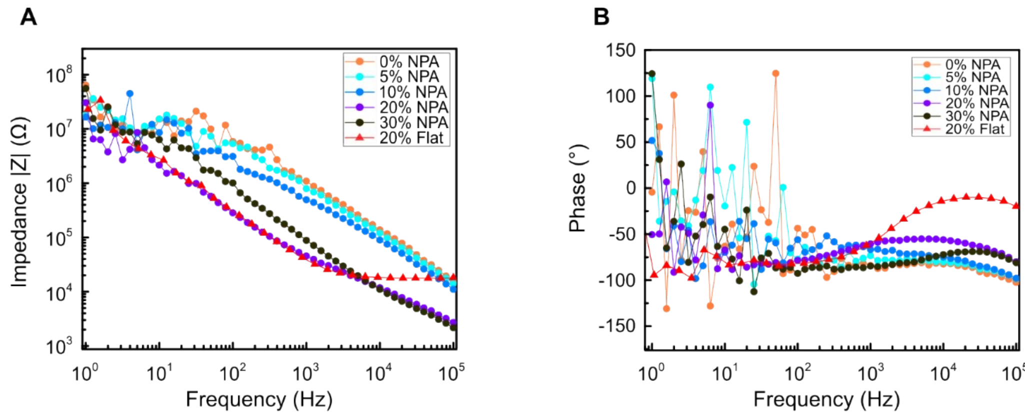

Figure S-2 Full range results of EIS measurement. (A) Impedance and (B) phase results of different MWCNT ratios and different conductive MWCNT/polymer composite structures.

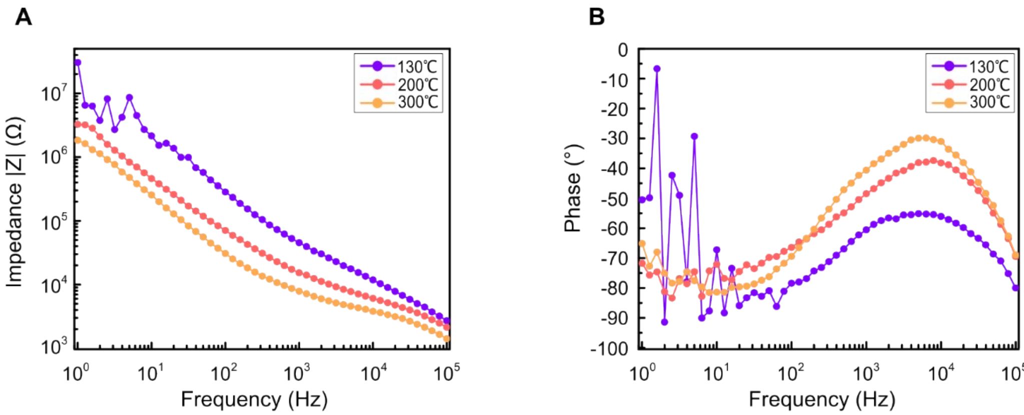

Figure S-3 Full range results of EIS measurement of annealing effect. (A) Impedance and (B) phase results of the annealing effect on 20 wt% conductive MWCNT/polymer composite NPAs.

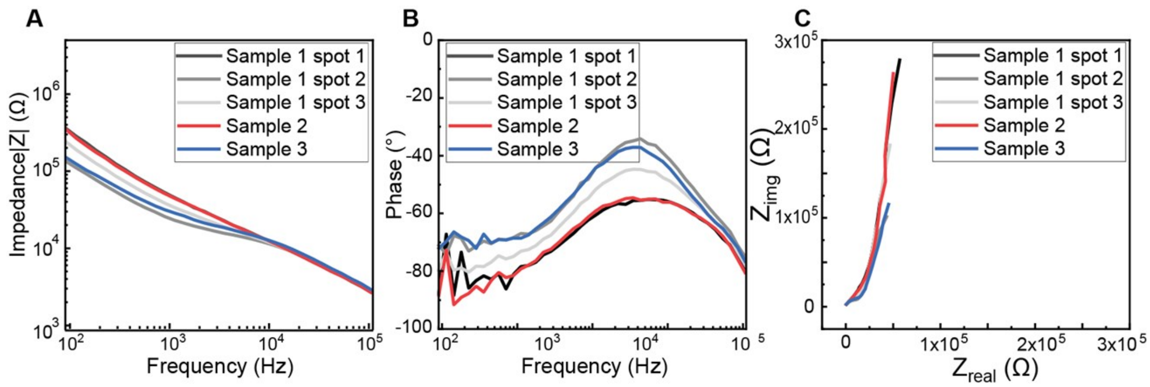

Figure S-4. EIS results from 3 different areas of 1 sample and 3 different samples. EIS measured (A) bode impedance |Z|, (B) bode phase angle and (C) Nyquist impedance plots for 20% MWCNT/polymer nanopillar arrays with 3 different areas from 1 sample and 3 different samples in 1X PBS (pH=7.4) in the frequency range from 10^2 Hz to 10^5 Hz.

We did EIS measurements at three different areas in each sample and three samples for each processing condition. Figure S-4 shows the new EIS results in bode plots and Nyquist plots for three different samples of 20% MWCNT/polymer nanopillar arrays at three different areas. Three different areas from one sample EIS results demonstrate the sample's uniformity, while three different samples' EIS results demonstrate our fabrication method's reproducibility. Figure S-4A shows the impedance of all conditions in a similar range and similar trend: as frequency increases from 10^2 Hz to 10^5 Hz, the impedance decreases from 10^5 Ω to 10^3 Ω. Meanwhile, figure S-4B shows that even the phase of all conditions has different values; they all follow a similar trend that increases first from ~-80° to -50° as the frequency increases from 10^2 Hz to 10^4 Hz then starts to decrease back to -80° as the frequency further increases to 10^5 Hz. Figure S-4C further illustrates the phase change difference and the impedance |Z| difference at the low-frequency range. Different spots and different samples have similar real parts, while the imaginary part causes the difference in phase and impedance |Z|. The difference in imaginary part value can be explained by the area-to-area difference and the sample-to-sample difference of the MWCNT network condition.

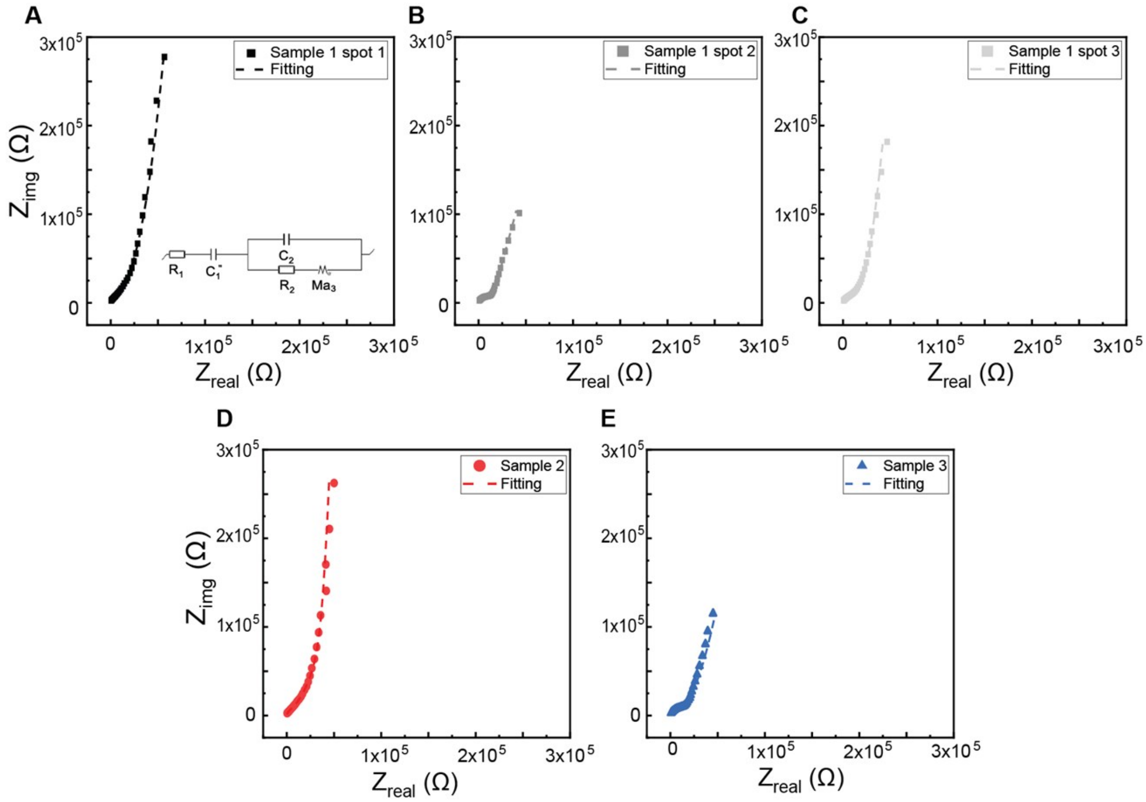

Figure S-5. Nyquist plots of different conditions and fitting with the same equivalent circuit model. Nyquist plot and fitting results for (A) spot 1, (B) spot2, (C) spot 3 on sample 1, (D) sample 2, and (E) sample 3 from 20% MWCNT/polymer nanopillar arrays in 1X PBS (pH=7.4) in the frequency range from 10^2 Hz to 10^5 Hz.

Condition \ Circuit components	$\chi^2/\lvert Z\rvert$	R_2 (Ω)	Rd_3 (Ω)	Wd_3 (rad/s)	a_3 (a.u.)	C2 (nF)	C1'' (F)
Sample 1, Spot 1	0.0038	3928	69589	0.4328	0.822	6.8	0.61
Sample 1, Spot 2	0.0221	4665	85904	0.2845	0.839	1.6	0.54
Sample 1, Spot 3	0.0094	4389	73421	0.3965	0.854	8.0	0.58
Sample 2	0.0398	4448	97763	0.2532	0.890	7.4	0.61
Sample 3	0.0771	4809	73680	0.4043	0.968	21.1	0.59

Table S-2. Table of fitting circuit parameters from 20% MWCNT/polymer nanopillar arrays.

We have plotted the Nyquist EIS results with fitted parameters using the same equivalent circuit model in the main manuscript (Figure S-5) and list them in a table to compare (Table S-2). From Figure S-5, we can tell that the fitting is matching the experiment results, and this is further confirmed by the small $\chi^2/|Z|$ values listed in table S-2. By comparing all the fitted parameters in table S-2, we find out that all the parameters are in the same range. The similar values of fitted parameters between different locations on the sample and between different sample batches manifest the good sample uniformity and good fabrication reproducibility for making MWCNT/polymer NPAs.