Supporting Information

Recycling non-food-grade tree gum wastes into nanoporous carbon for sustainable energy harvester

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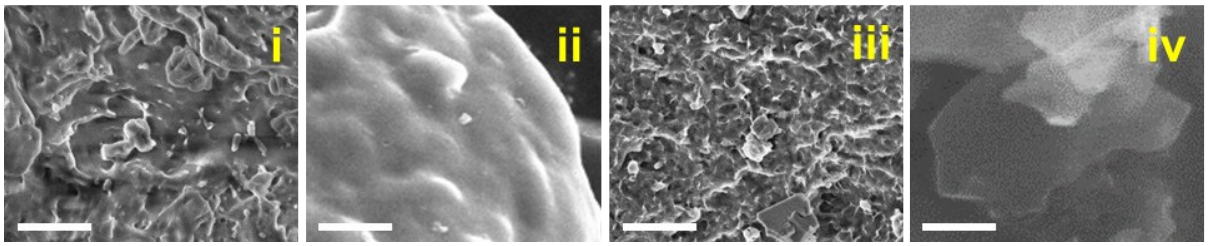

Figure S1. SEM images of (i) pristine gum and subsequent products after (ii) carbonization, (iii) exfoliation, and (iv) sonication. (scale bars: 1 μm)

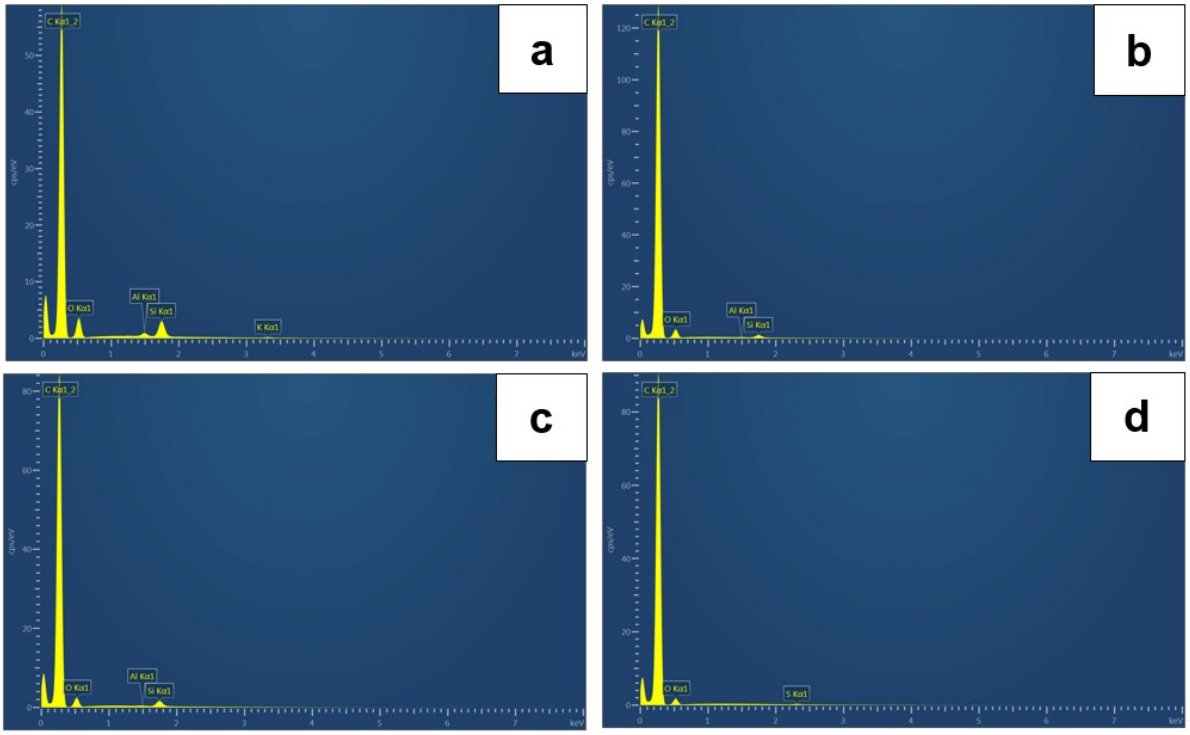

Figure S2. EDX results of (a) GAnC, (b) GGnC, (c) GKnC, and (d) XGnC.

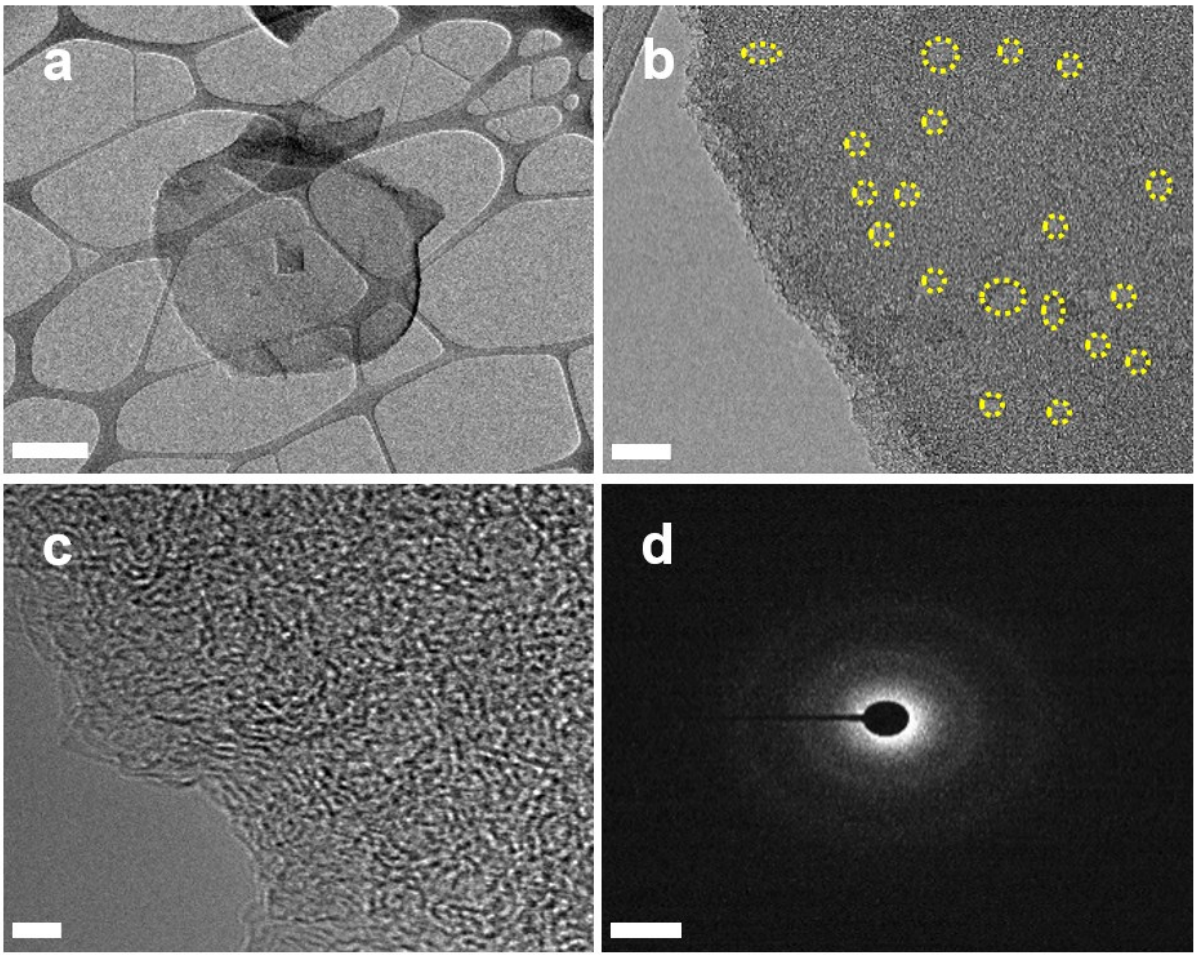

Figure S3. TEM image of XGnC in (a) low and (b) medium magnification. (c) HRTEM and (d) SAED patterns of XGnC. (Scale bar in a), b), c), and d): 0.5 μm, 50 nm, 2 nm, and 5 1/nm)

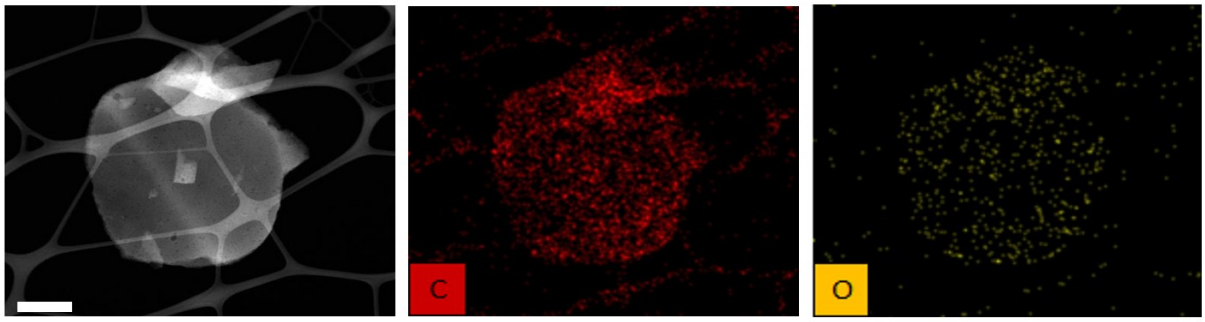

Figure S4. HAADF-STEM image and corresponding elemental mapping of XGnC.

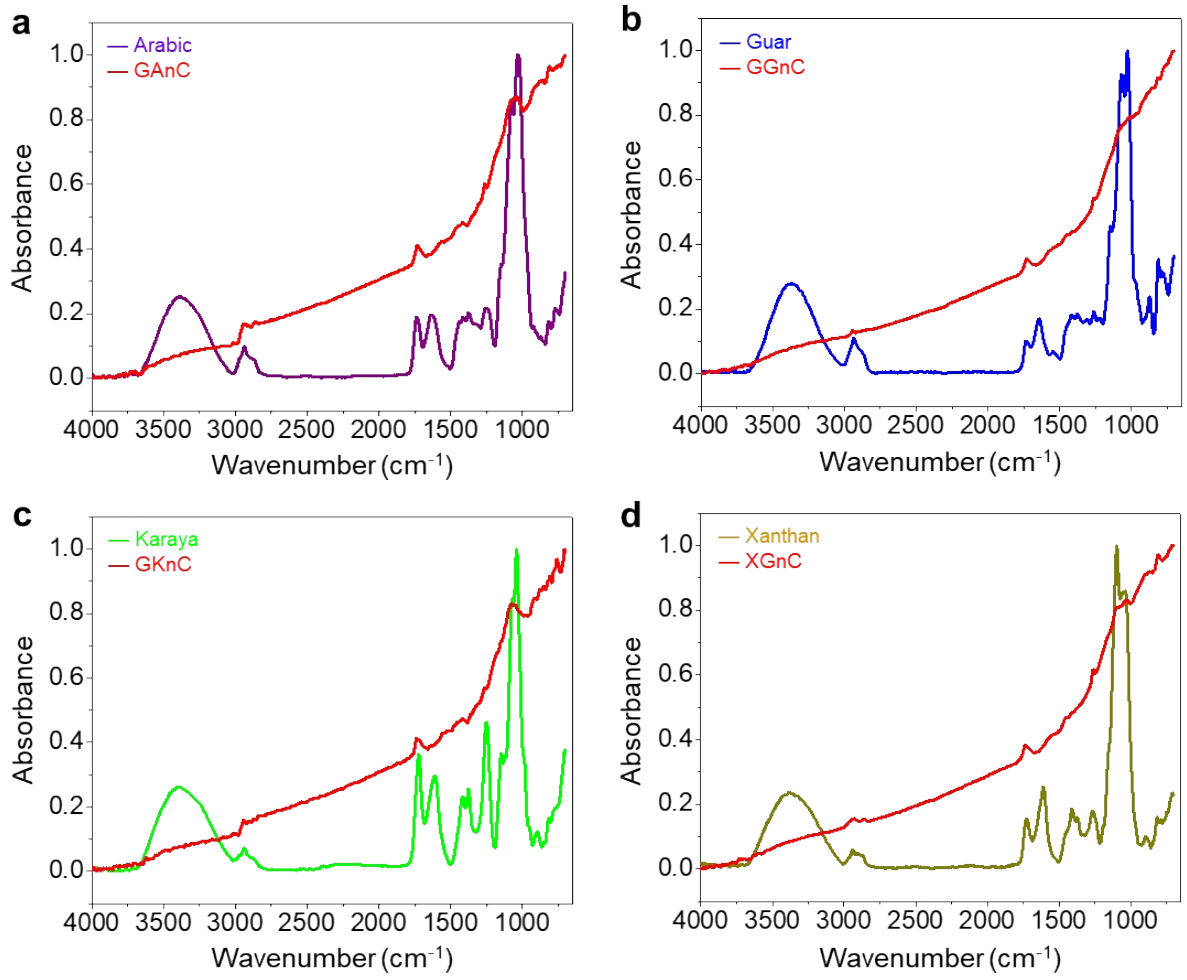

Figure S5. FT-IR results of (a) GAnC, (b) GGnC, (c) GKnC, and (d) XGnC.

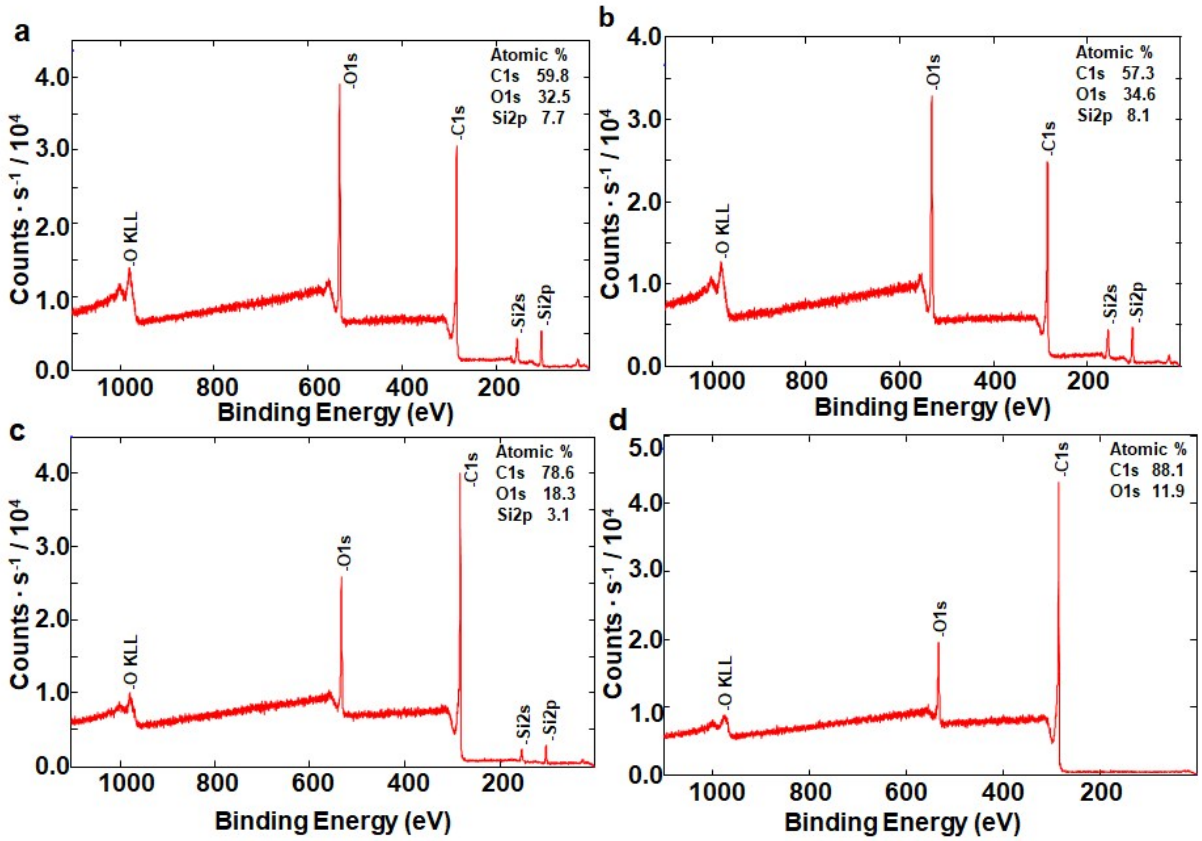

Figure S6. XPS survey spectrum of (a) GAnC, (b) GKnC, (c) GGnC, and (d) XGnC.

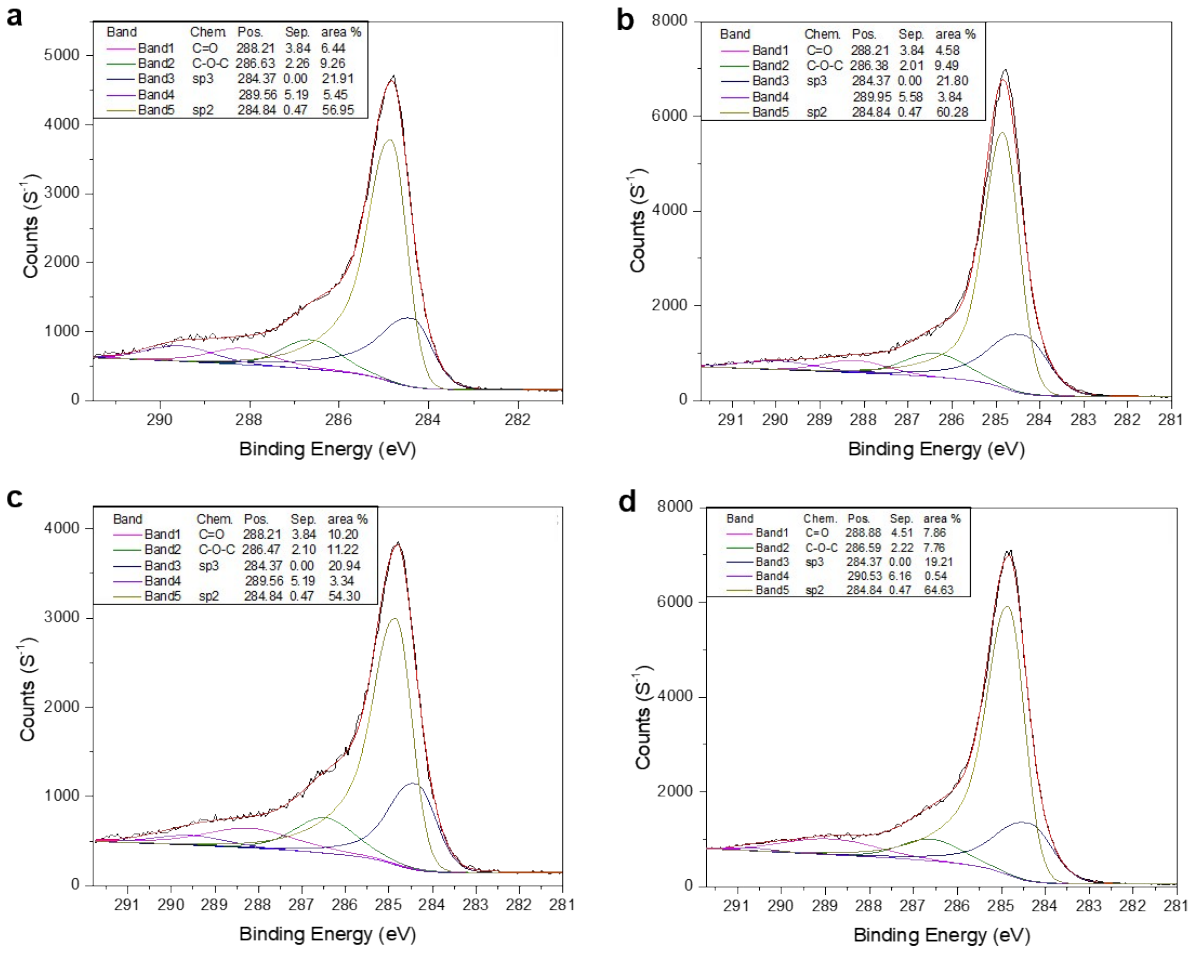

Figure S7. C 1s spectrum of (a) GAnC, (b) GGnC, (c) GKnC, and (d) XGnC.

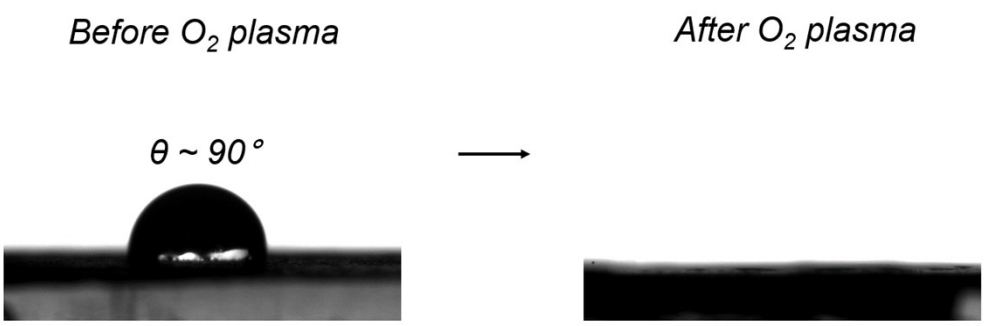

Figure S8. Contact angle measurement before/after O_2 plasma treatment.

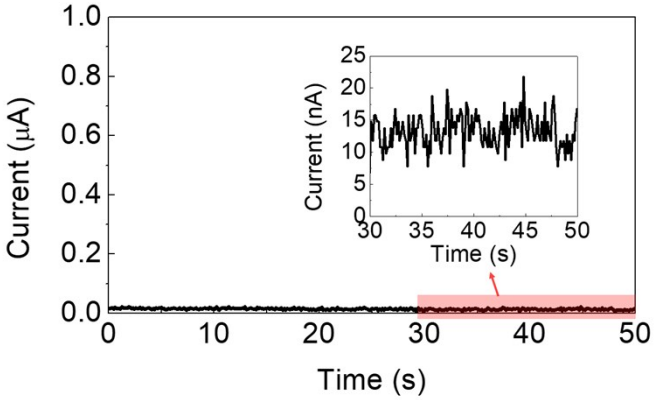

Figure S9. Output measurement of binder consisting of PAA and CMC without nC.

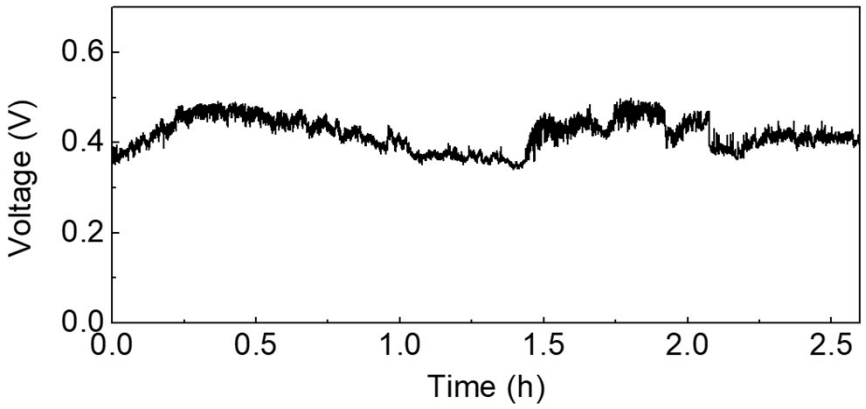

Figure S10. Long-term output measurement over 2 h, showing the continuous electricity generation of nC-based energy harvester.

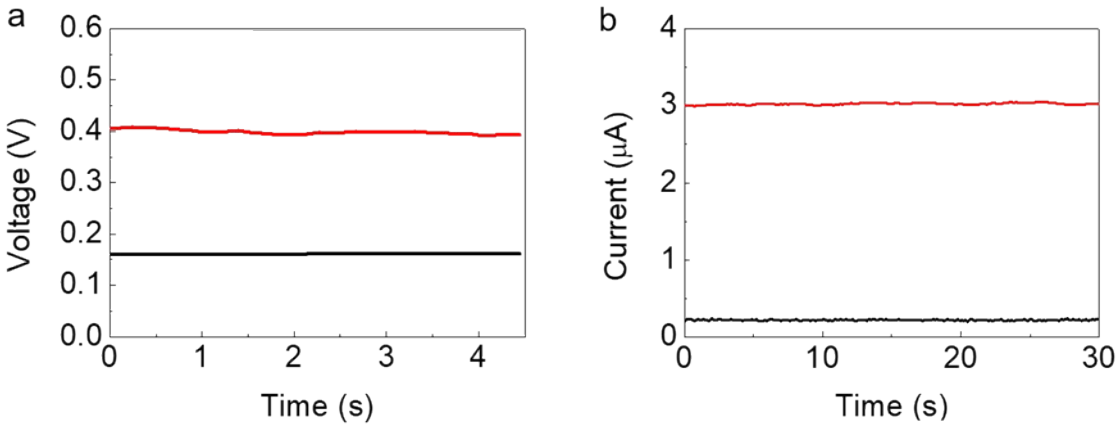

Figure S11. (a) Voltage and (b) current generation of carbon black (black) and nC (red).

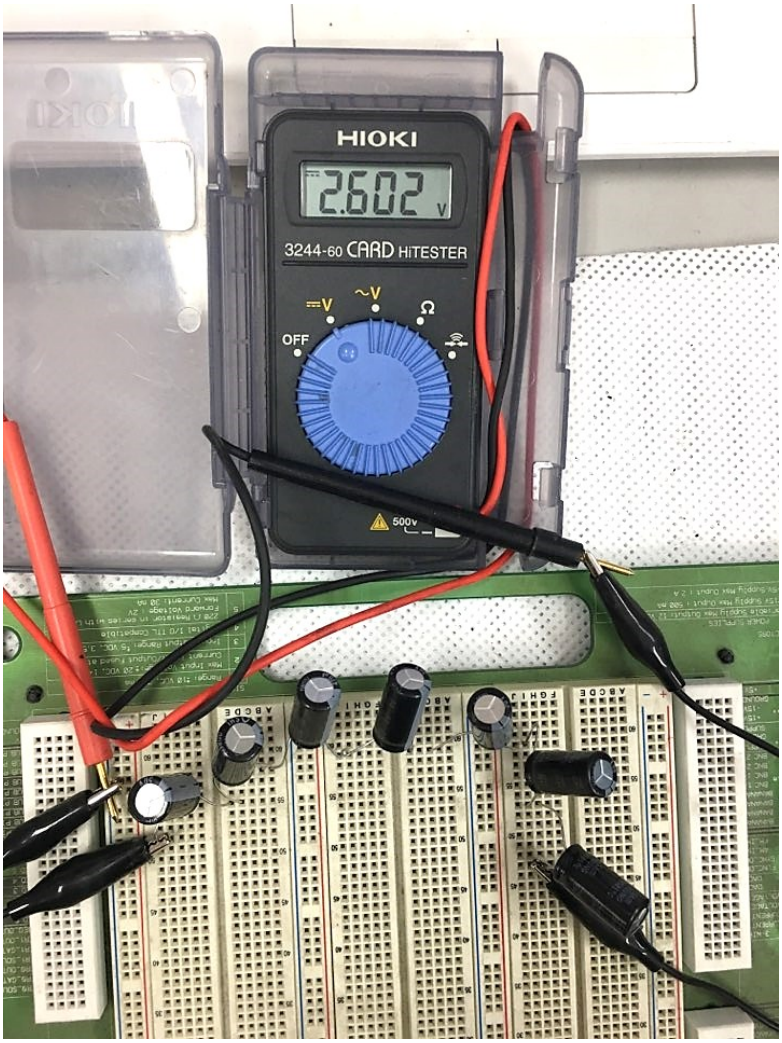

Figure S12. Charged output voltage of ~2.6 V using serially connected 7 capacitors of 470 μF.

Table S1. Final product yield for all the gums.

Gums	Initial weight (g)	Final weight (g)	Yield (%)
GA	10	2.179	21.79
GG	10	1.918	19.18
GK	10	2.257	22.57
XG	10	2.114	21.14

Table S2. Functional group analysis of GA, GG, GK, and XG by FTIR.

Gums	wave number (cm^{-1})	Functional group assignment
GA	3382	-OH
	2933	-C-O, C-H stretching
	1737	-C=O (acetyl group)
	1249	-C-OH
	1029	-C-O-C stretching
GG	3384	-OH
	2938	-C-O, C-H stretching
	1735	-C=O (acetyl group)
	1261	-C-OH
	1027	-C-O-C
GK	3399	-OH
	2937	-C-O, C-H stretching
	1718	-C=O (acetyl group)
	1415	COO-
	1251	-C-OH
	1041	-C-O-C stretching.
XG	3380	-OH
	2938	-C-O, C-H stretching
	1721	-C=O (acetyl group)
	1425	COO-
	1035	-C-O-C stretching

Table S3. Raman peak positions and intensity ratios of the nC derived from various gums.

Material	D band (cm^{-1})	G band (cm^{-1})	2D (cm^{-1})	S3 (cm^{-1})	I_G/I_D
GAnC	1338	1588	2694	2861	1.05
GGnC	1339	1591	2715	2890	1.02
GKnC	1339	1595	2721	2849	1
XGnC	1344	1593	2702	2878	1.06

Table S4. Surface area and pore volume of nC derived from different gums.

Material	Surface area ($m^2.g^{-1}$)	Pore Volume ($cm^3.g^{-1}$)
GAnC	1630	0.79
GGnC	1340	0.59
GKnC	1480	0.70
XGnC	1780	0.88

Supporting Movies

Movie S1: Turning on a LED by charging capacitors using power source of nC-based water energy harvester.