nanomaterials

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Supplementary Materials

Advanced Cellulose–Nanocarbon Composite Films for High-Performance Triboelectric and Piezoelectric Nanogenerators

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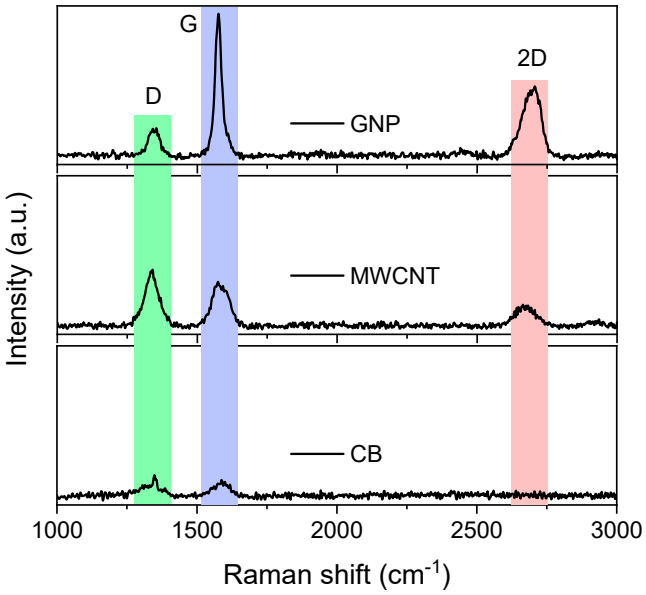

Figure S1. Raman spectra of CB, MWCNT and GNP. The D and G bands of sp^3 and sp^2 hybridized carbon are highlighted as well as the 2D band attributed to π stacking interactions.

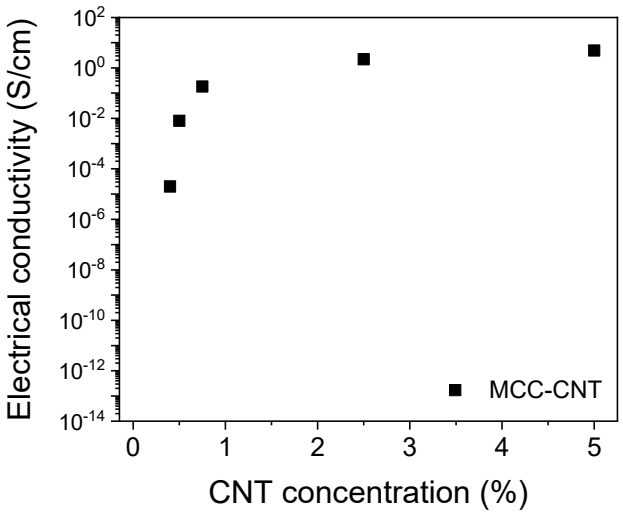

Figure S2. Electrical conductivity of MCC-CNT films.

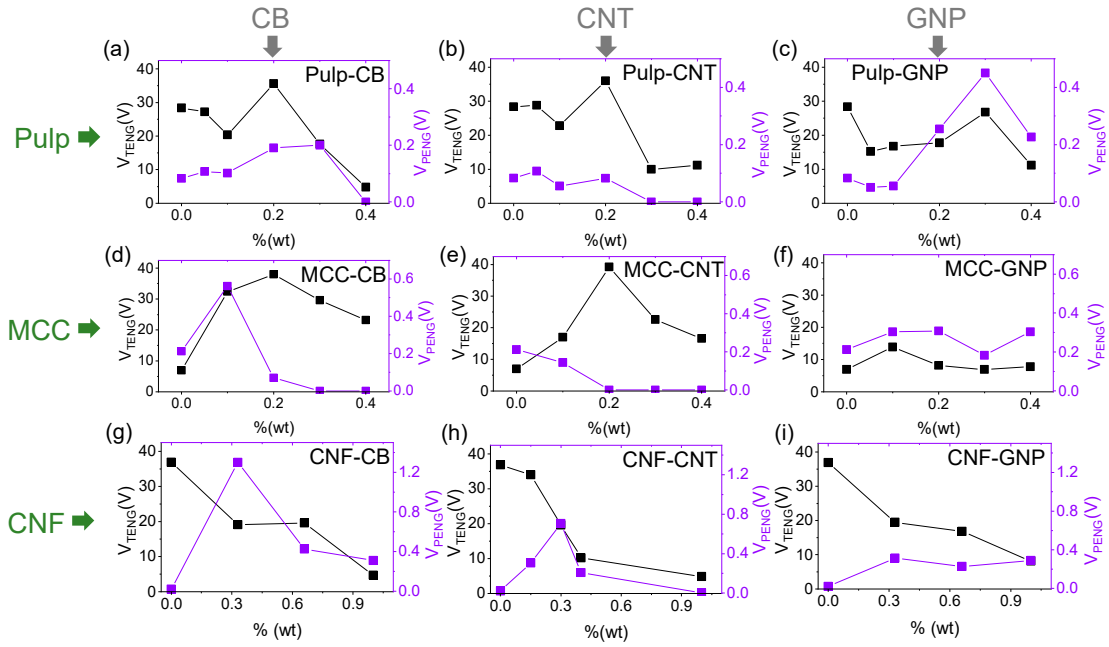

Figure S3. Tribo- and piezoelectricity voltage of all nine combinations as a function of the nanocarbon filler content. Pulp-CB (a), Pulp-CNT (b), Pulp-GNP (c), MCC-CB (d), MCC-CNT (e), MCC-GNP (f), CNF-CB (g), CNF-CNT (h), CNF-GNP (i).

Table S1. Properties of the nanocarbon fillers.

	Particle size (nm) Diameter x length	**BET SSA (m^2/g)**	**Electrical conductivity (S/cm)**	**True density (g/cm^3)**	**Ref.**
CB	35	250	10^{-4}	1.80-1.98	[1], [2],[3],[4]
CNT	10 x 1,500	300	$10^{1} – 10^{3}$	1.75-2.10	[5], [6],[7],[8]
GNP	5-100 x 1,000-10,000	30-60	10^{2}	2.25	[9]

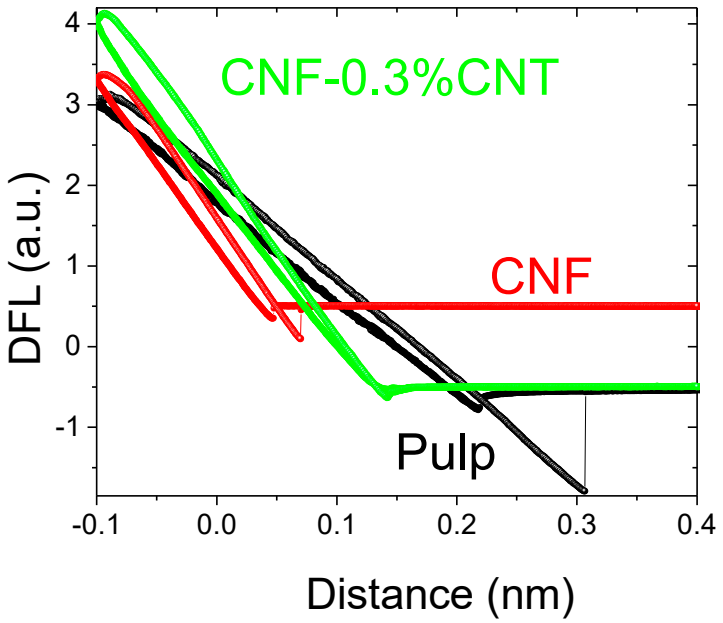

Figure S4. Local force spectroscopy measurements of CP, CNF and CNF-0.3%CNT samples representing laser deflection (DFL) versus tip distance.

Local force spectroscopy measurements in Figure S4 demonstrate that the CP sample is the softest one possessing higher adhesion of the sample surface, while CNF and CNF-0.3CNT are similar in rigidity (i.e. equal tracks in forward and backward behavior on DFL-distance curves) but very different in adhesion behavior (i.e. different points of tip-sample surface contact on the distance axis). The CNF-0.3CNT represents very low adhesion behavior related to the strong influence of electrostatic force due to surface charges trapped by CNT. At the same time, all the samples demonstrate elastic deformation-type behavior.

References

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