Supplementary information

High performance dielectric composites by latex compounding of graphene oxide-encapsulated carbon nanosphere hybrids with XNBR

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Table S1. The element analysis of CNS, GO, GO@CNS and RGO@CNS.

Samples	Relative atomic percentage (%)		
	C	O	N
CNS	92.90	5.61	0.91
GO	69.77	28.78	1.45
GO@CNS	82.08	16.44	1.48
RGO@CNS	86.44	12.23	1.33

Table S2. Summary and comparison of dielectric properties and conductivity of representative advanced DE composites at room temperature.

Composites	Percolation threshold	Maximum content	Percolation threshold			Maximum content		
			Dielectric constant (at 10^3 Hz)	Dielectric loss (at 10^3 Hz)	Conductivity (S/m)	Dielectric constant (at 10^3 Hz)	Dielectric loss (at 10^3 Hz)	Conductivity (S/m)
CNT/PDMS [1]	2.0 wt. %	2.0 wt. %	10^6	10^5	10^{-2}	10^6	10^5	10^{-2}
FGS/PDMS [1]	2.0 wt. %	2.0 wt. %	14	10^{-1}	10^{-6}	14	10^{-1}	10^{-6}
MWNT/PDMS [2]	2.0 wt. %	10.0 wt. %	250	<1	10^{-5}	1700	10	10^{-3}
MWNT-OH/PDMS [2]	4.0 wt. %	10.0 wt. %	480	<1	10^{-6}	1000	3	10^{-4}
EG/EVA [3]	10.9 vol. %	13.6 vol. %	<10	/	10^{-6}	<10	/	10^{-5}
MWNT/EVA [3]	8.0 vol. %	12.0 vol. %	<10	/	10^{-6}	<100	/	10^{-4}
CNF/EVA [3]	6.2 vol. %	10.3 vol. %	<10	/	10^{-6}	<100	/	10^{-3}
poly(CuPc)/EVA [4]	30 wt. %	70 wt. %	7.8	1.0	/	7.4	2.2	/
Graphite/PU [5]	11.90 vol. %	13.52 vol. %	100	$>10^3$		200	$>10^3$	
CB/TPU [6]	1.25 vol. %	1.25 vol. %	10	<0.1	10^{-7}	10	<0.1	10^{-7}
GS-HBA-TPU [7]	/	5 wt. %	/	/	/	920	1.2	/
MWCNT-1/TPE[8]	0.1 vol. %	0.12 vol. %	60	/	10^{-6}	300	/	10^{-4}
RGO@CNS/XNBR in our study	0.25 vol. %	0.75 vol. %	45	0.56	10^{-8}	400	0.63	10^{-7}

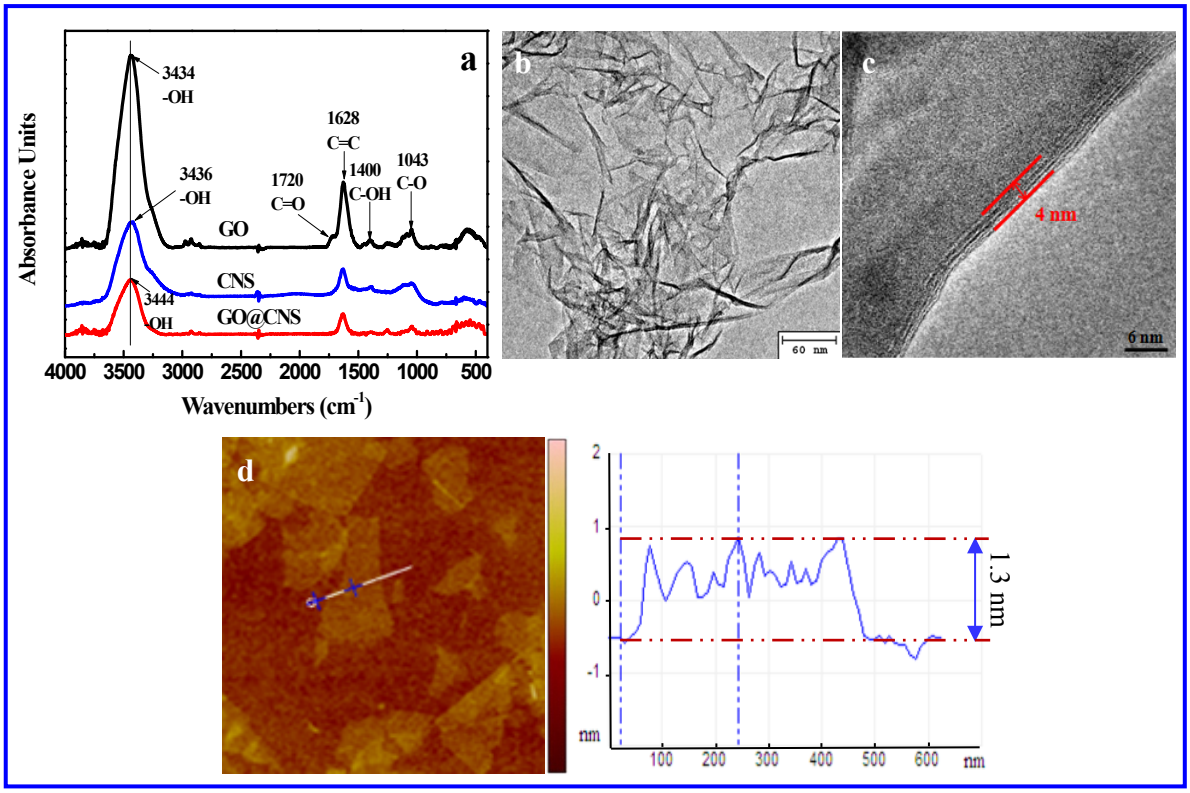

Fig.S1 FTIR spectra of (a) CNS, GO and GO@CNS hybrid, HRTEM images of GO (b) in low magnification and (c) in high magnification, and (d) AFM height image (left) and cross-section (right) of single-layer GO nanosheets (The cross-section identified by the white and straight line shows the height of GO nanosheets). Typical thickness is about 1.3 nm.

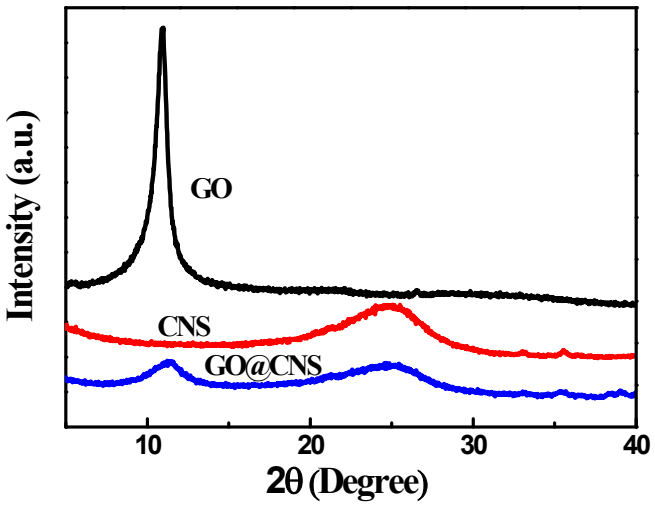

Fig.S2 X-ray diffraction of GO, CNS and GO@CNS.

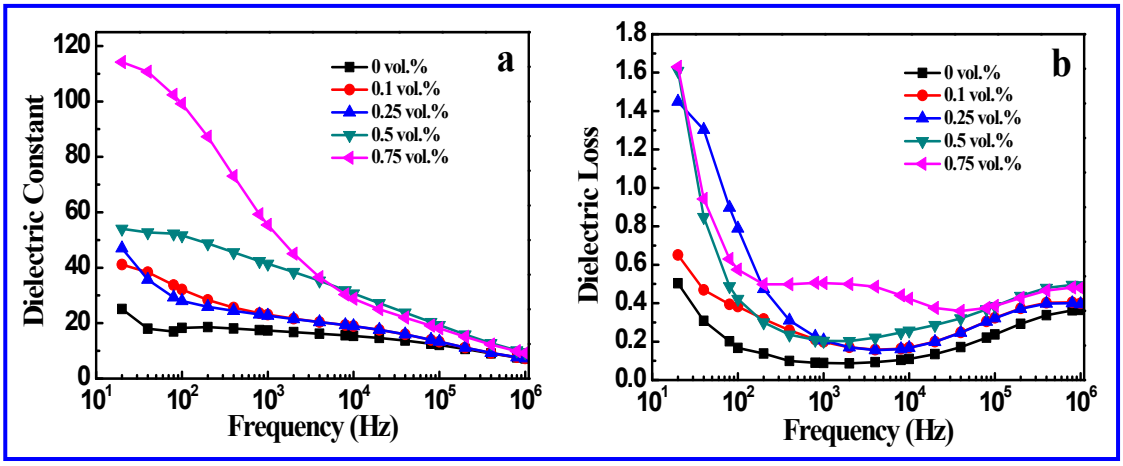

Fig.S3 Frequency response of (a) dielectric constant and (b) dielectric loss of XNBR composites with different contents of CNS.

Reference

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