Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Substantially Enhancing Energy Storage Capability of Dielectric Polymer Nanocomposites via Room Temperature Coulomb Blockade Effect of Ultra-Small Platinum Nanoparticles

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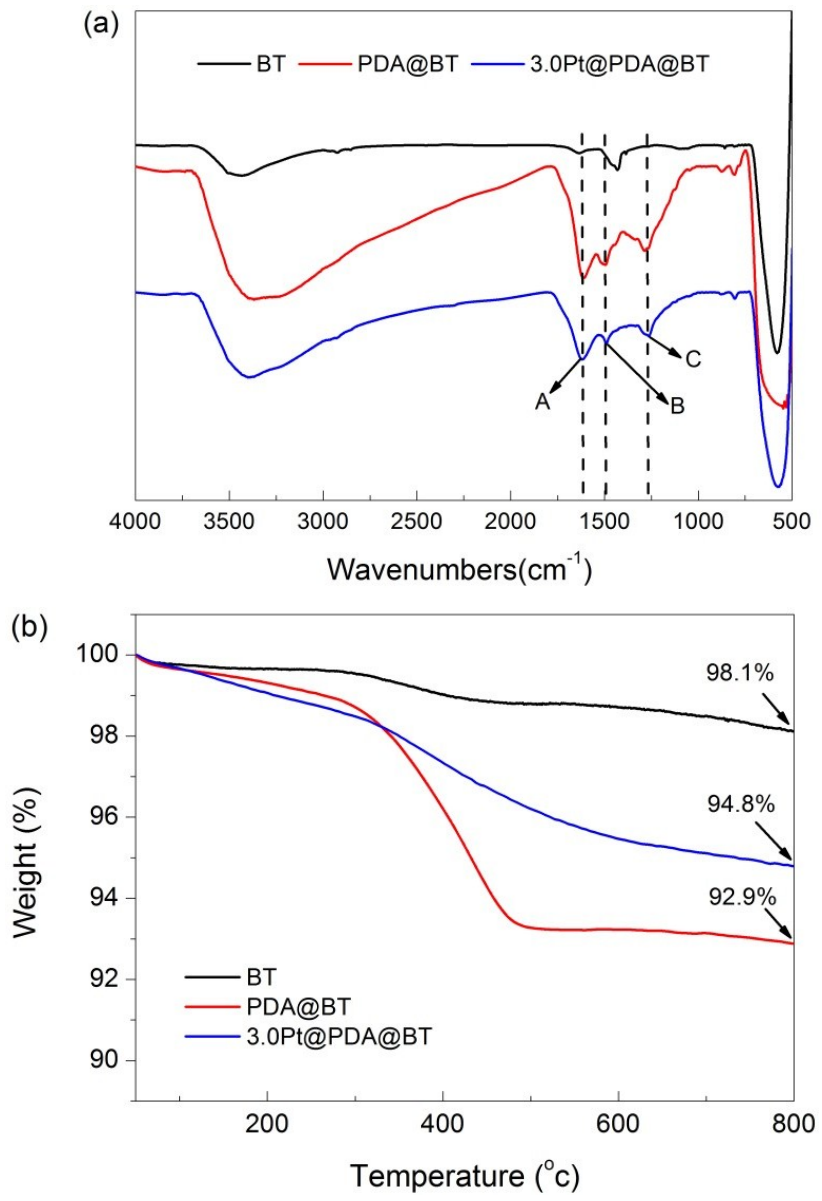

Figure S1. FT-IR spectra (a) and TGA curves (b) of BT, PDA@BT and Pt@PDA@BT nanofiller.

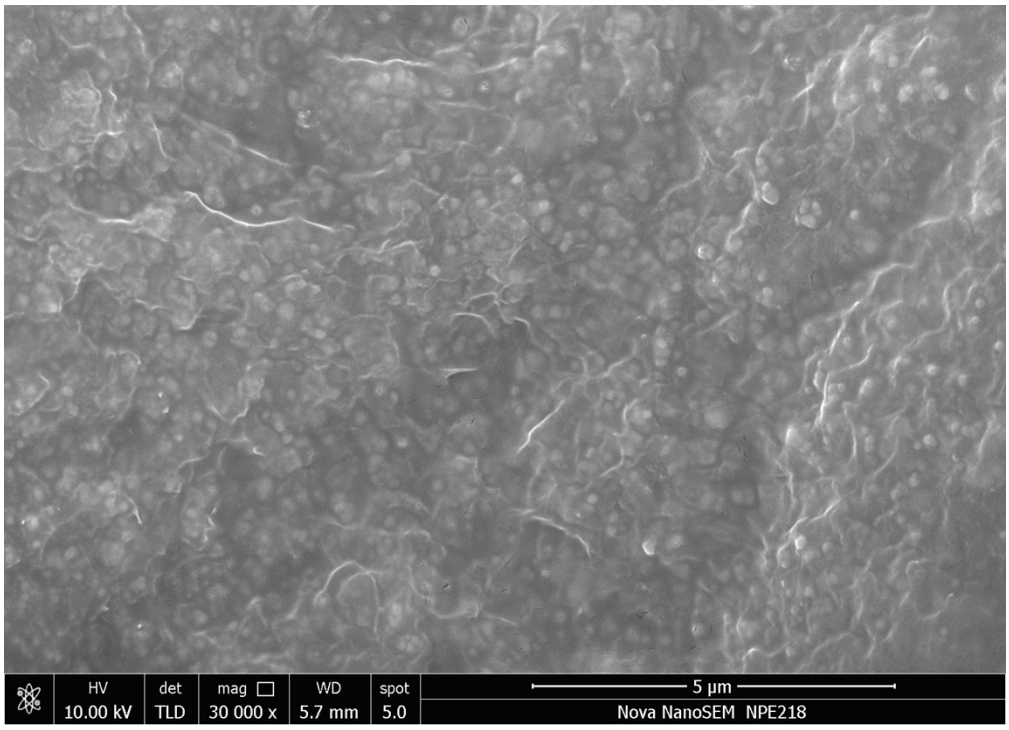

Figure S2. SEM images of nanocomposites with 1.0Pt@PDA@BT

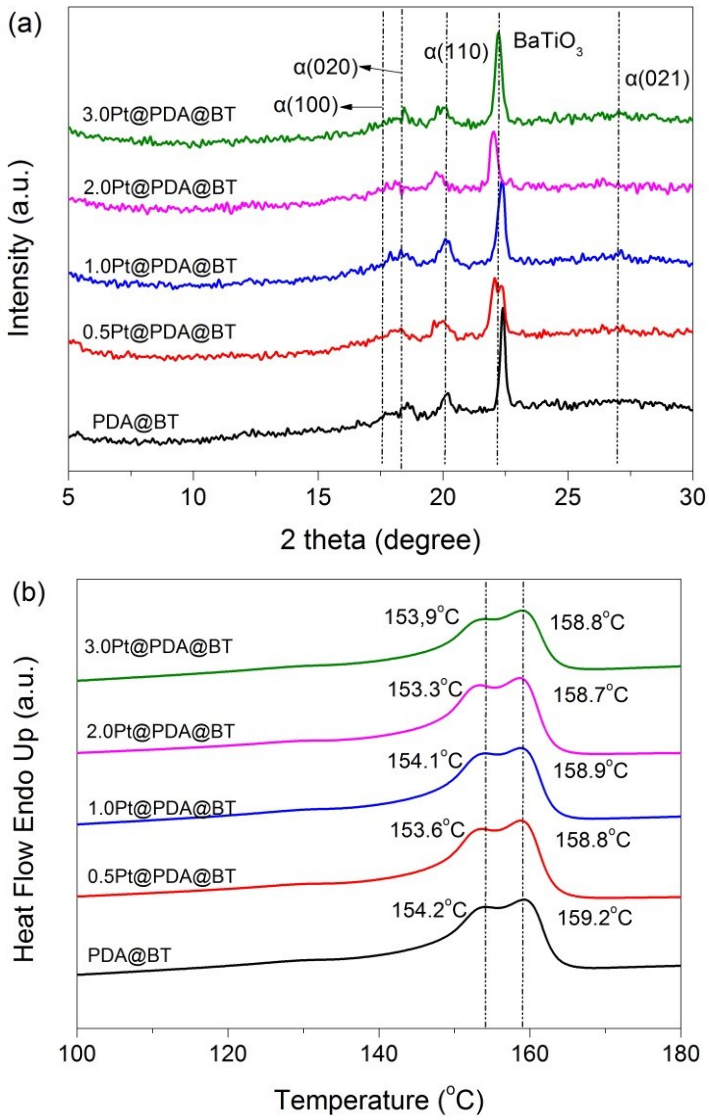

Figure S3. XRD and DSC melting curves of the PDA@BT and Pt@PDA@BT nanocomposites.

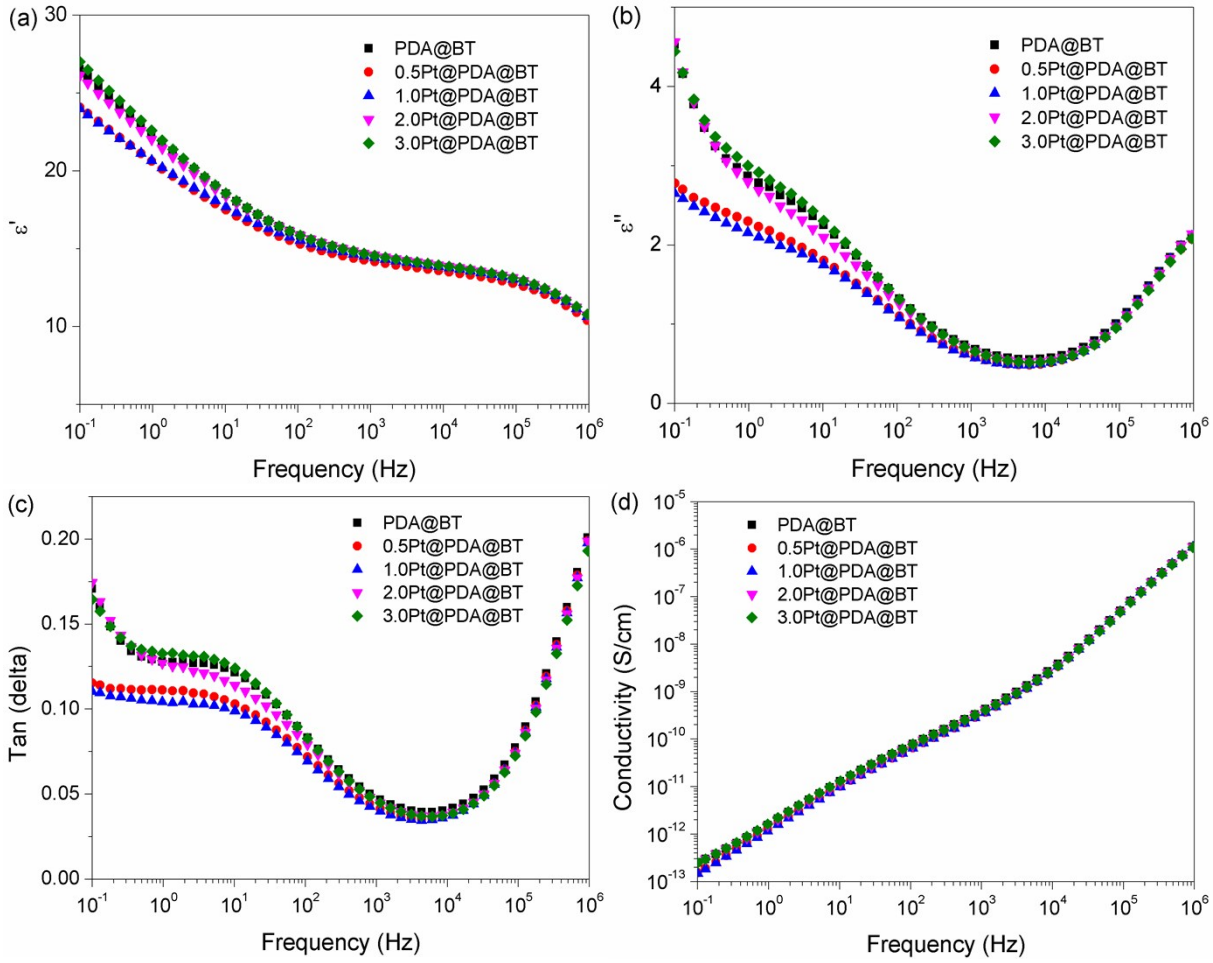

Figure S4. The dielectric properties of the PDA@BT and Pt@PDA@BT nanocomposites: ε´, ε´´, tan delta, and conductivity;

Figure S4d shows that, regardless of the concentration of the ultra-small Pt particles, the Pt@PDA@BT nanocomposites have comparable frequency dependent electrical conductivity in comparison with the PDA@BT nanocomposites. This may be caused by the low electric field used for dielectric measurement.

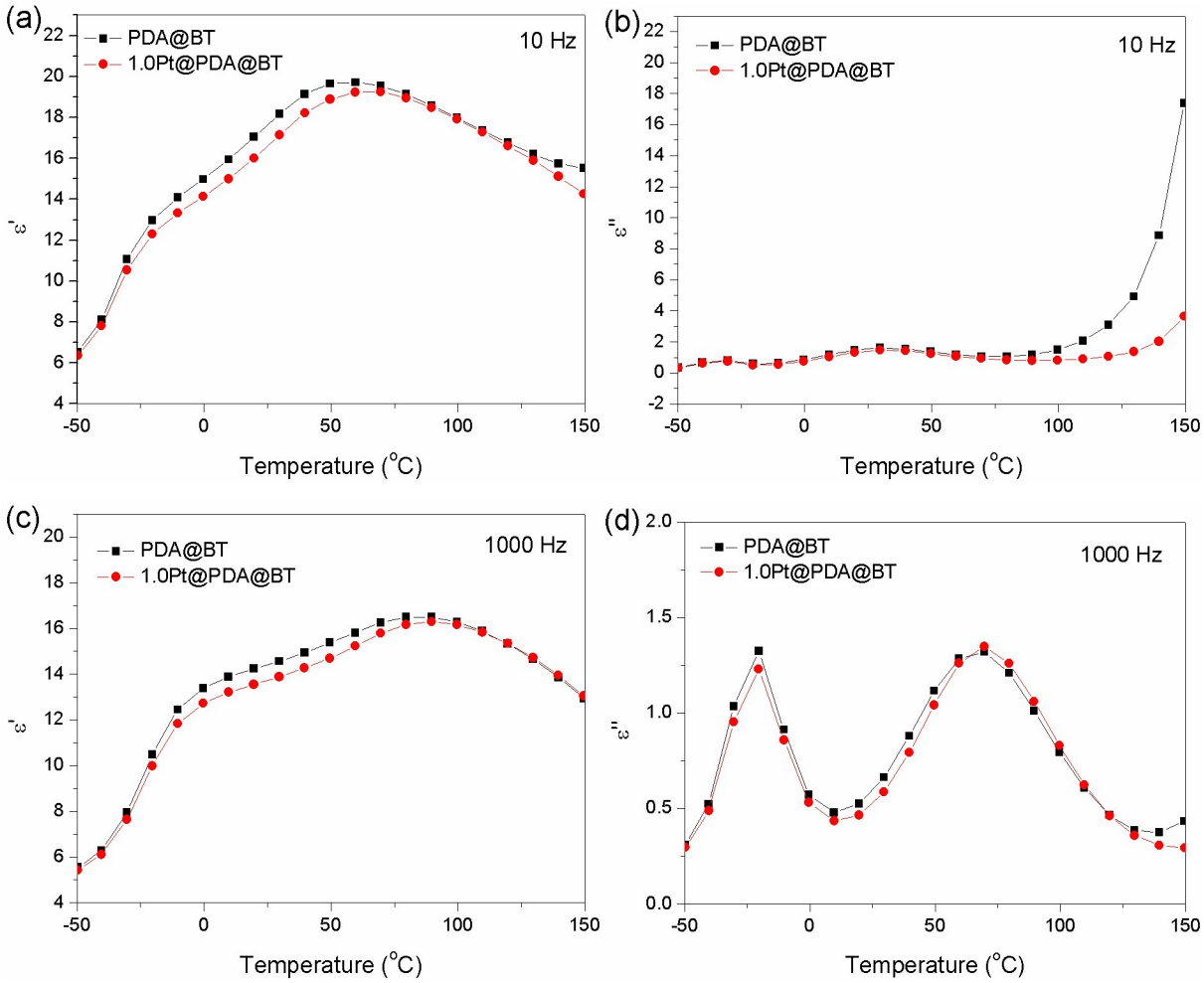

Figure S5. Temperature dependent real (a) and imaginary (b) dielectric constant of PDA@BT and 1.0Pt@PDA@BT at 10 Hz; Temperature dependent real (a) and imaginary (b) dielectric constant of PDA@BT and 1.0Pt@PDA@BT at 1000 Hz;

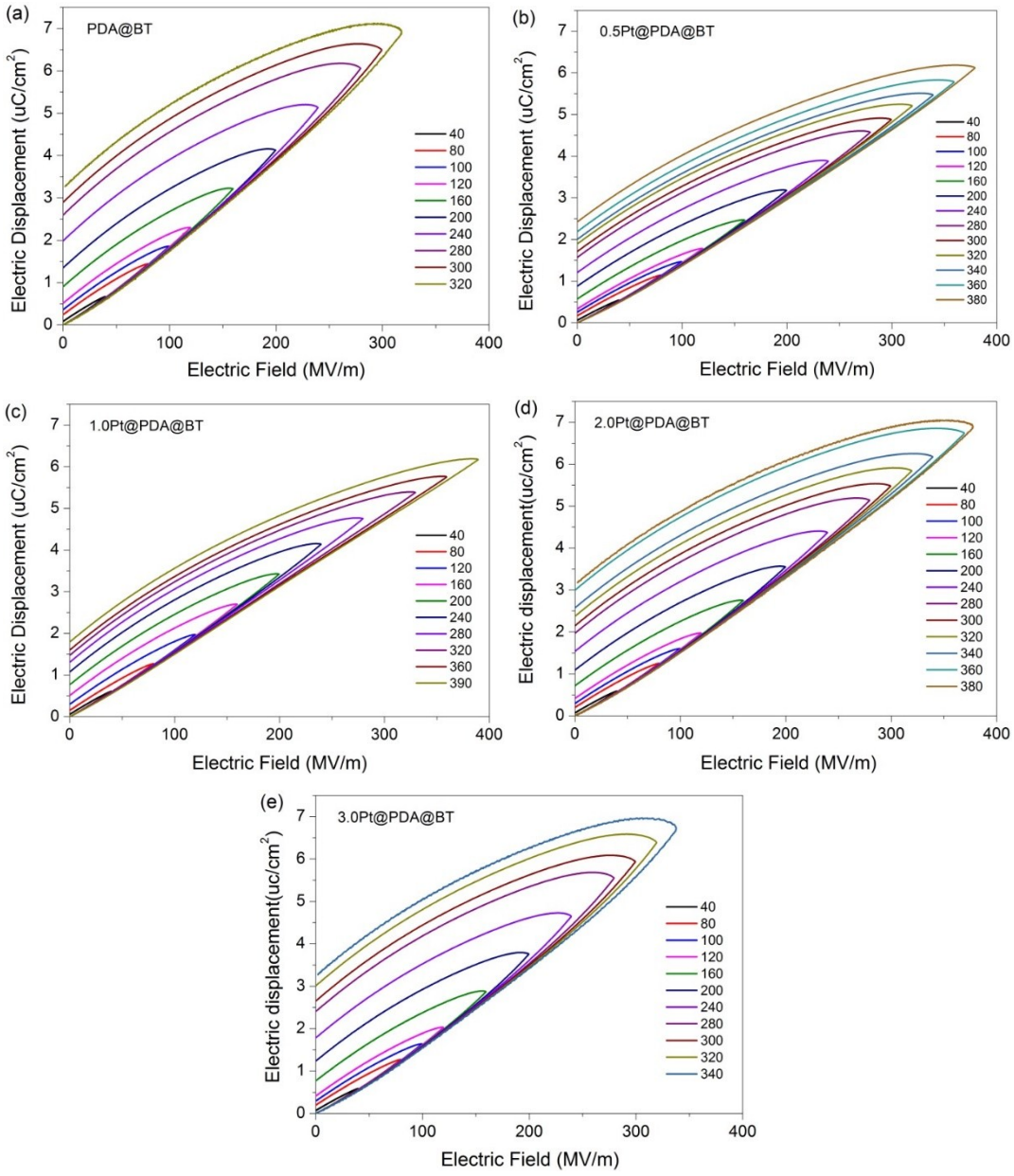

Figure S6. Unipolar D-E loops of the nanocomposites with PDA@BT (a), 0.5Pt@PDA@BT (b), 1.0Pt@PDA@BT (c), 2.0Pt@PDA@BT (d), and 3.0Pt@PDA@BT (e);

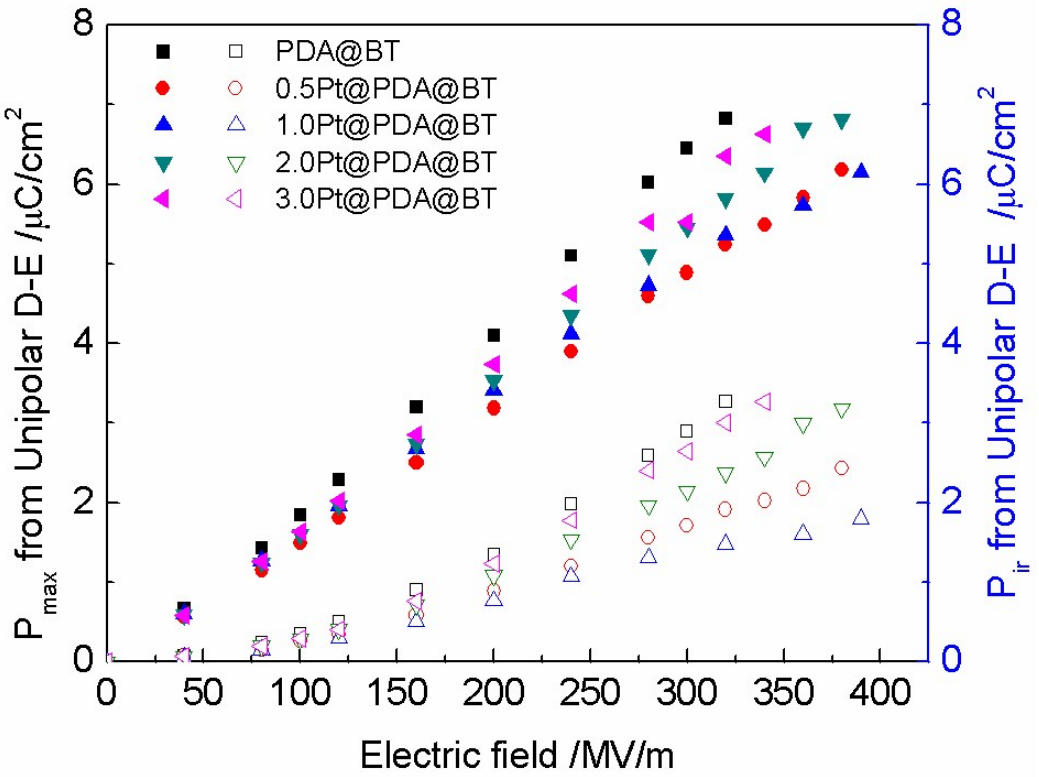

Figure S7. Electric field dependent electric displacement at both maximum field (referring to P_{max} from unipolar D-E loops of the nanocomposites) and zero electric field (referring to the irreversible polarization P_{ir} from unipolar D-E loops of the nanocomposites).

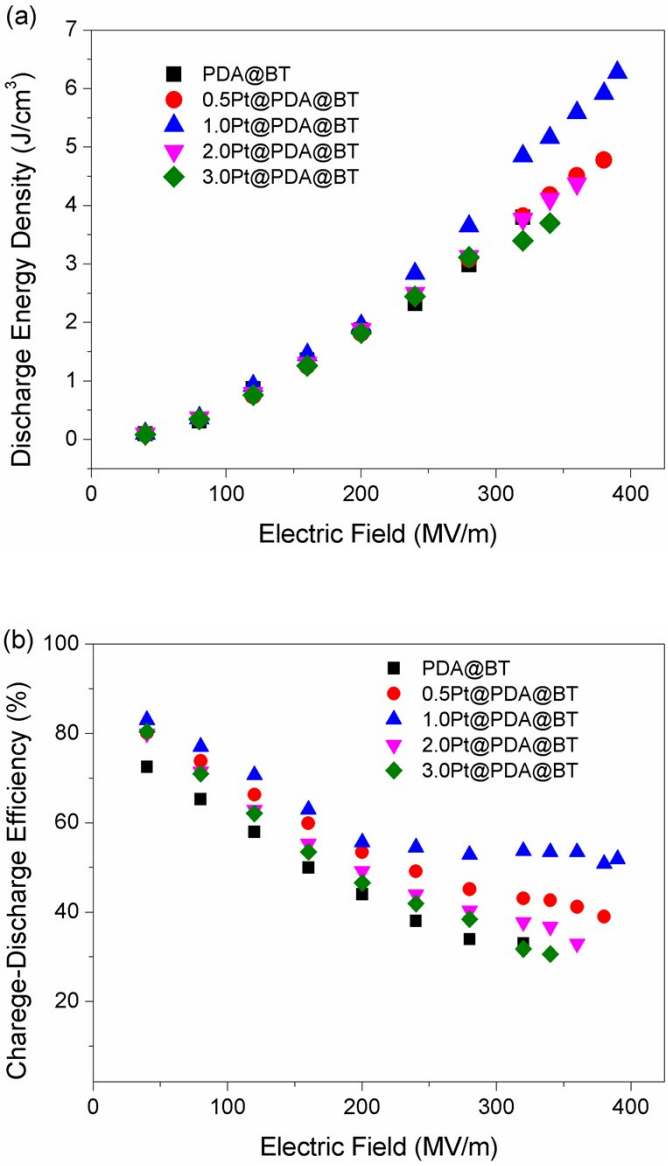

Figure S8. The discharged energy density and charge-discharge efficiency of the PDA@BT and Pt@PDA@BT nanocomposites.

Table S1. The calculated results according to Equation 2 when d = 10 μm

The radius of nano-pt / Calculation Results	r=1nm	r=2nm	r=3nm
$2\pi\varepsilon_0\varepsilon\sqrt{(d^2-4r^2)}$	6.68×10^{-15}	6.68×10^{-15}	6.68×10^{-15}
arccosh(d/2r)	9.21	8.52	8.11
coth{ (j+1/2)arccosh(d/2r)}-1	0.0002	0.0004	0.0006
Capacitance C /aF	1.3351	2.6703	4.0066
$e^2/2C$ / $\times10^{-24}$ J	9.6132	4.8066	3.2035
T{$(e^2/2C)/k_b$} /k	696.28	348.14	232.02

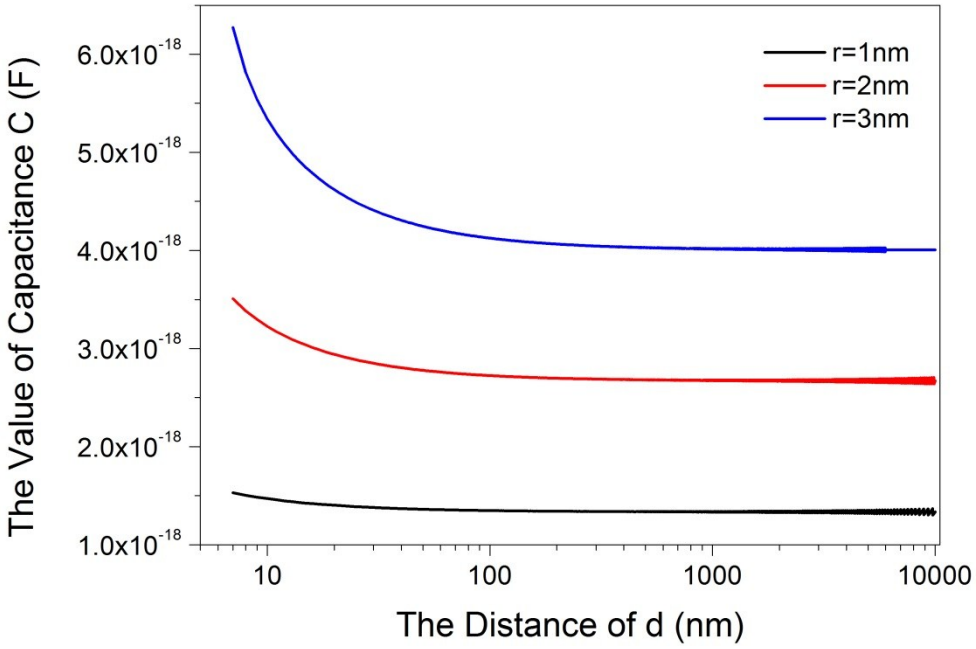

Figure S9. The value of the capacitance C with the change of distance of d

According to the calculation results, one can see that the value of C is almost proportional to the radius of nanoparticles but almost independent on the distance of d. When r = 1nm, the corresponding estimate of $e^2/2C \approx 9.6132\times10^{-24}$ J, the temperature is about 696.28 K. So, the effect of Coulomb blockade can occur theoretically at room temperature.