Supporting information

Facile fabrication of multilayer films of graphene oxide/ copper phthalocyanine with high dielectric properties

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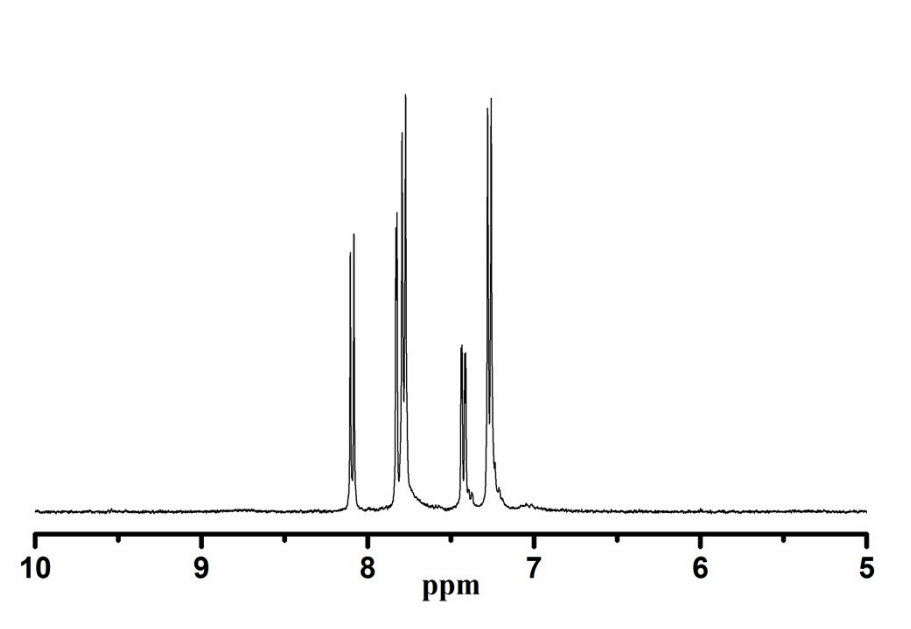

Fig.S1. ^{1}H NMR spectrum of CuPc.

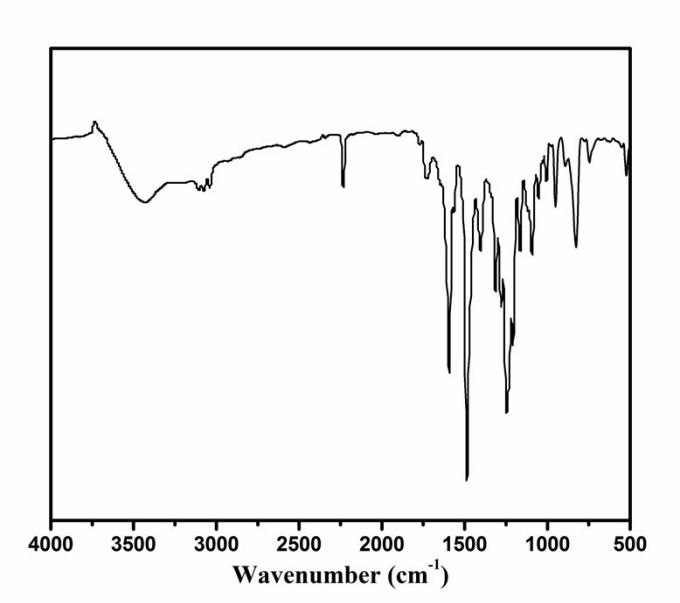

Fig.S2. FTIR spectrum of CuPc.

Content of phthalocyanine ring in CuPc was calculated as 10.7 % based on the following observation. CuPc itself had ε = 281[1]. ε value of CuPc unit (ε_{CuPc_unit}) in this structure was calculated as ε=171.5. ε value of CuPc oligomer ($\varepsilon_{CuPc\_oligomer}$) obtained in this paper was found by UV-vis spectra (Fig.S3(b)) as ε=18.4. CuPc unit contents in CuPc oligomer (*Contents* (%)) was obtained by the equation bellow. [1] Whalley M. J. Chem. Soc.1961, 866- 869.

$$Contents(\%) = \frac{\varepsilon_{CuPc\_oligomer}}{\varepsilon_{CuPc\_unit}} \times 100\% = \frac{18.4}{171.5} \times 100\% = 10.7\%$$

TGA: 415 °C (5% weight loss) (**Fig.S4**);

GPC: Mw=3266, Mn=2317, Mw/Mn=1.41.

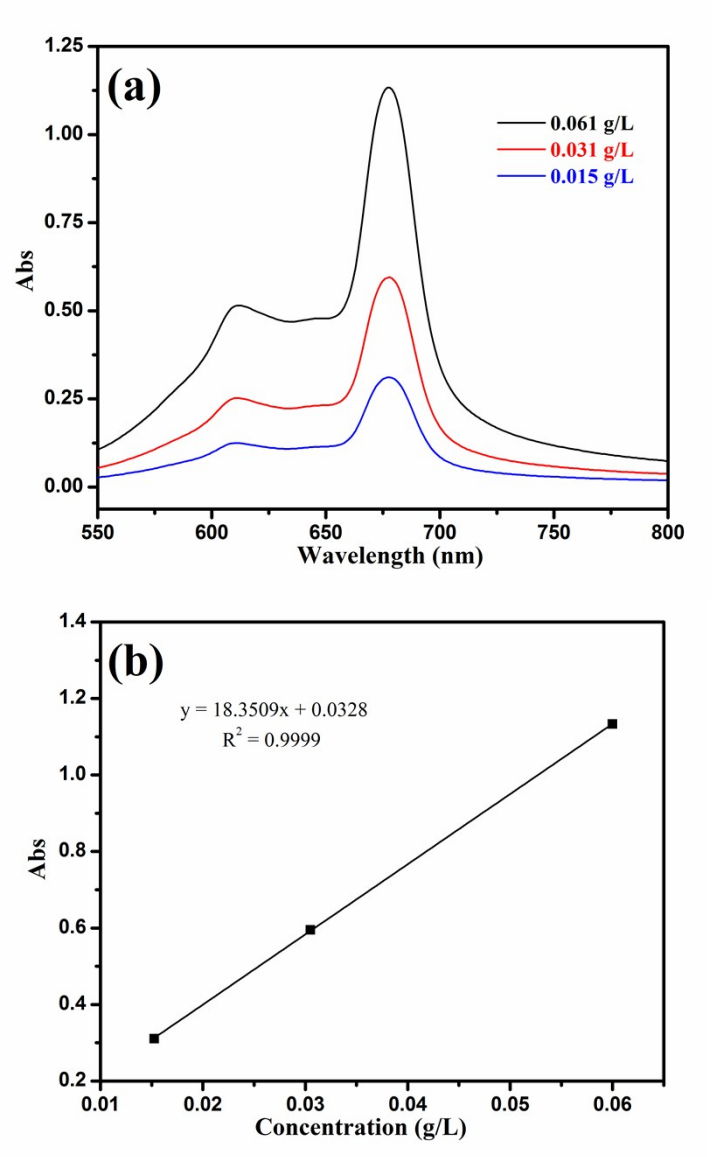

Fig.S3. UV-vis spectrum and ε of CuPc.

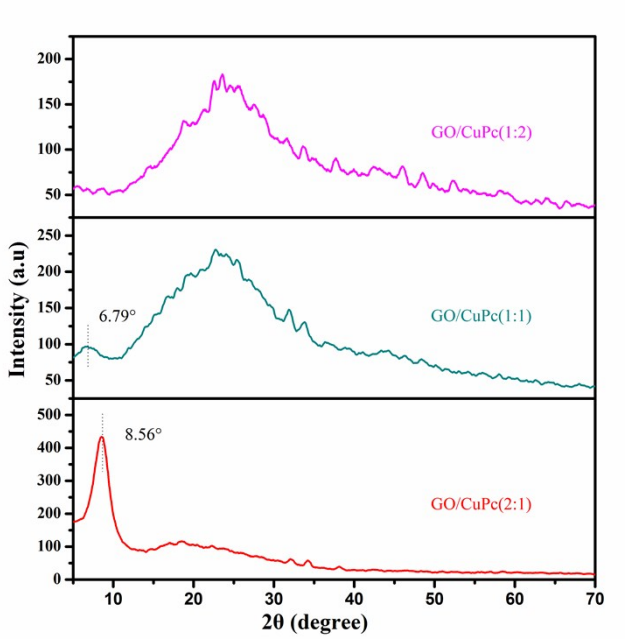

Fig.S4 XRD patterns of ordered GO/CuPc multilayer films with different ratios of GO and CuPc.

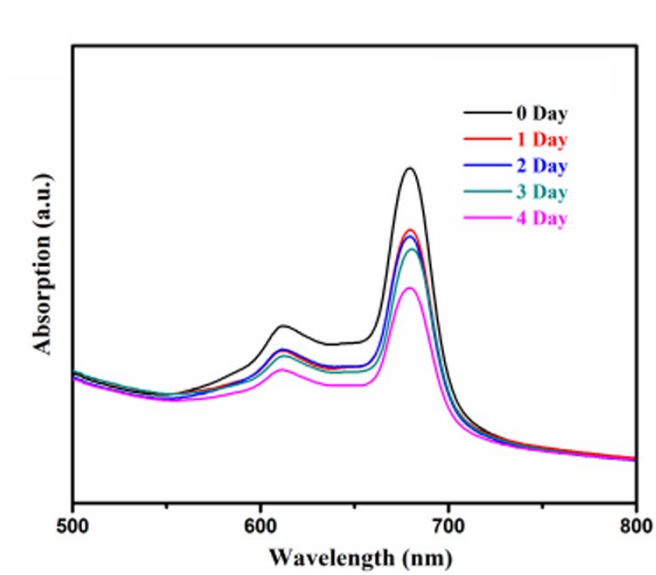

Fig.S5 UV-vis curves of GO/CuPc dispersion self-assembled for different time.

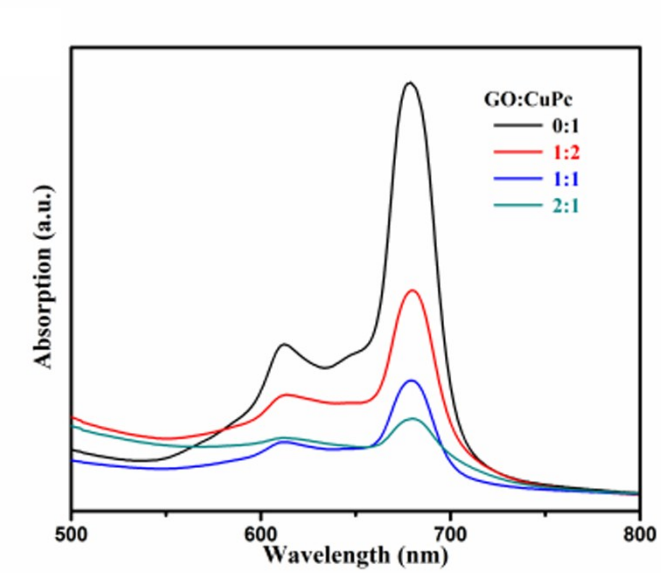

Fig.S6 UV-vis curves of the fresh prepared GO/CuPc dispersion with different concentrations of GO.

Table S1 The shoulder peak and Q-band in UV-vis curves of GO/CuPc dispersion self-assembled for different time.

	I_S	Shoulder peak (nm)	I_Q	Q-band (nm)	I_S / I_Q
0 Day	0.387	612	0.732	679	0.528
1 Day	0.333	612	0.598	679	0.557
2 Day	0.336	612	0.583	680	0.576
3 Day	0.322	613	0.555	680	0.580
4 Day	0.291	613	0.471	680	0.618

I_S is the intensity of shoulder peak and I_Q is the intensity of Q-band. I_S/I_Q is the intensity ratio of shoulder peak and Q-band.

Table S2 The shoulder peak and Q-band in UV-vis curves of fresh prepared CuPc and GO/CuPc dispersion.

	I_S	Shoulder peak (nm)	I_Q	Q-band (nm)	I_S / I_Q
0:1	0.934	612	2.404	679	0.389
1:2	0.536	612	1.043	679	0.514
1:1	0.387	612	0.732	679	0.528
2:1	0.410	612	0.518	679	0.792

I_S is the intensity of shoulder peak and I_Q is the intensity of Q-band. I_S/I_Q is the intensity ratio of shoulder peak and Q-band.

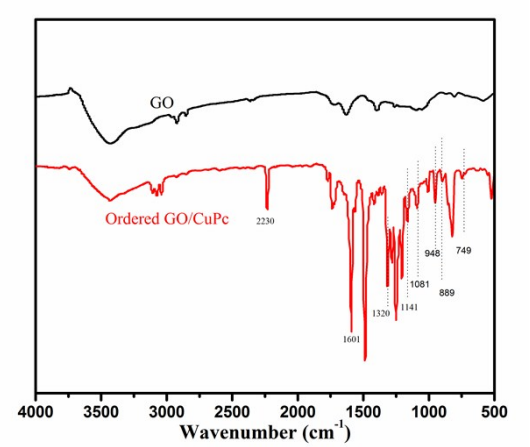

Fig.S7 FTIR spectra of GO and the multilayer film of GO/CuPc.

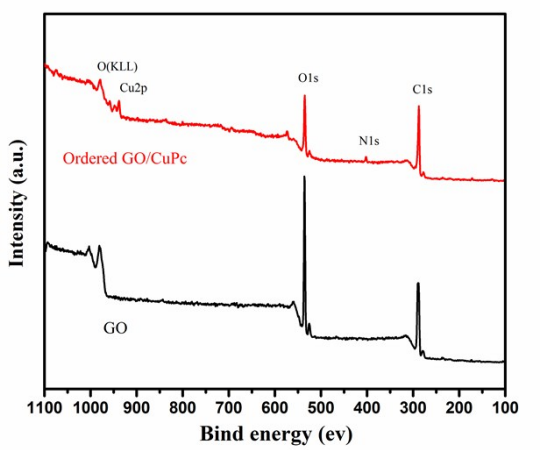

Fig.S8 XPS spectra of GO and the multilayer film of GO/CuPc.

Table S3 Atomic concentrations of GO and multilayer films of GO/CuPc.

Sample	C (at%)	O (at%)	N (at%)	Cu (at%)	C/O ratio
GO	67.07	32.93	0	0	2.04
multilayer films of GO/CuPc	70.90	24.46	3.28	1.37	2.90

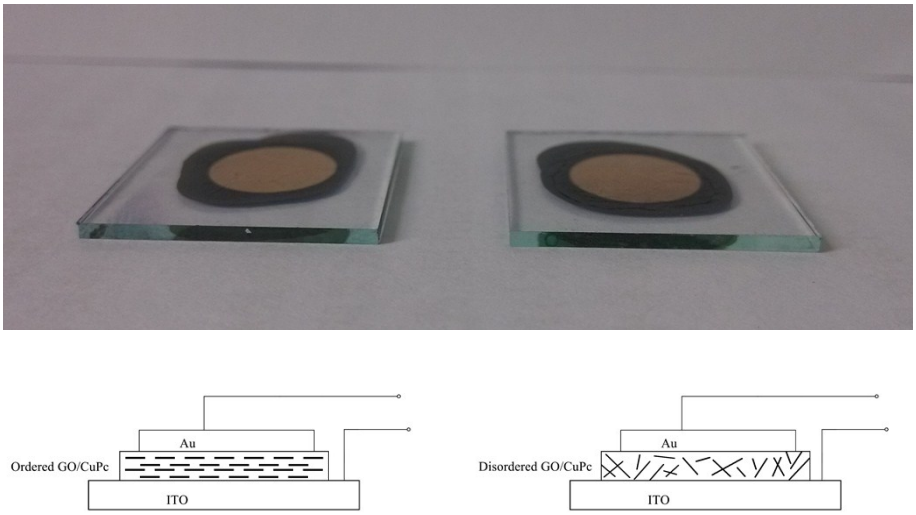

Fig.S9. Pictures of the capacitor (top) and schematic illustration (bottom) of parallel-plate capacitor of the GO/CuPc multilayer film (left) and disordered GO/CuPc composite (right).

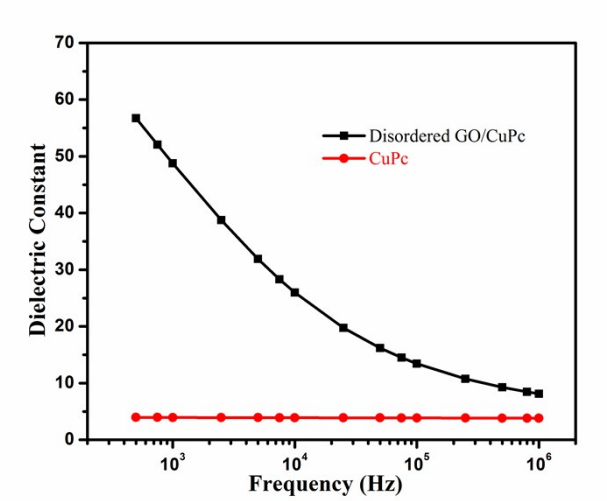

Fig.10 Dielectric constant of disordered GO/CuPc and CuPc.

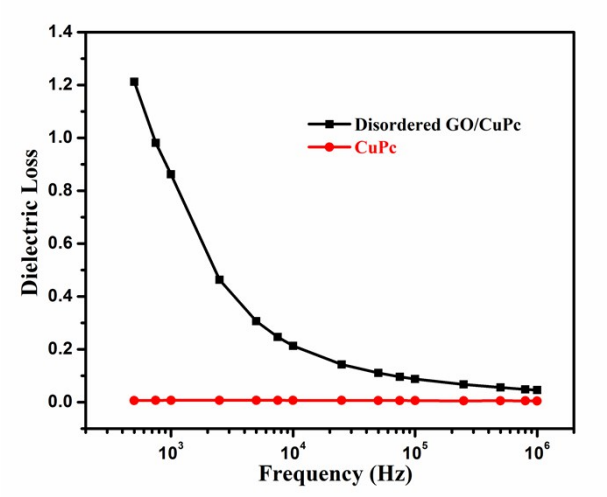

Fig.11 Dielectric losses of disordered GO/CuPc and CuPc.