Boosting Dielectric and Electrical Performance of Perovskite Material by Collaborative Augmentation with Reduced Graphene Oxide Nanosheets for Cutting-edge Storage Solutions.

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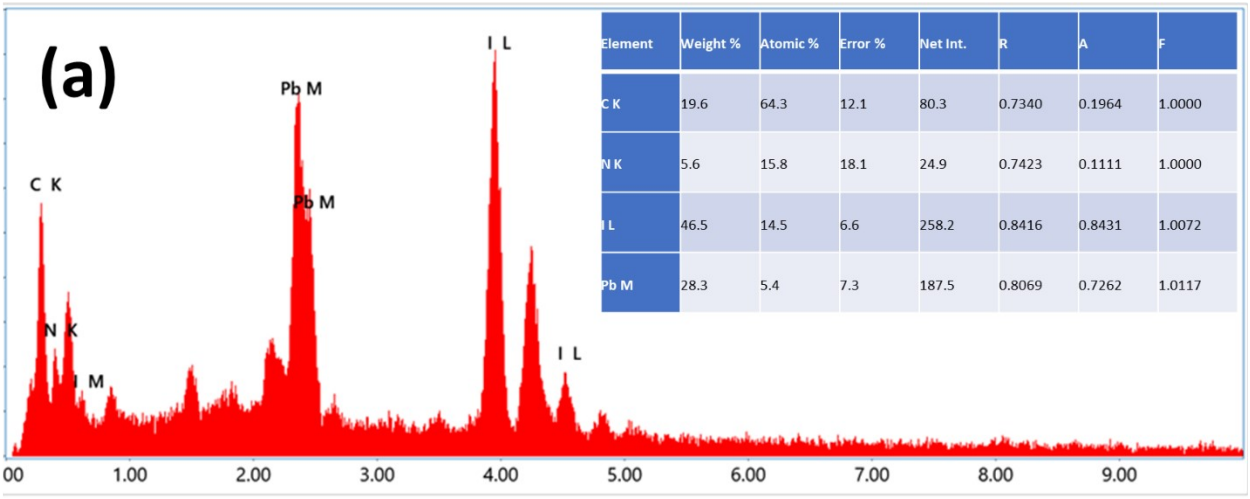
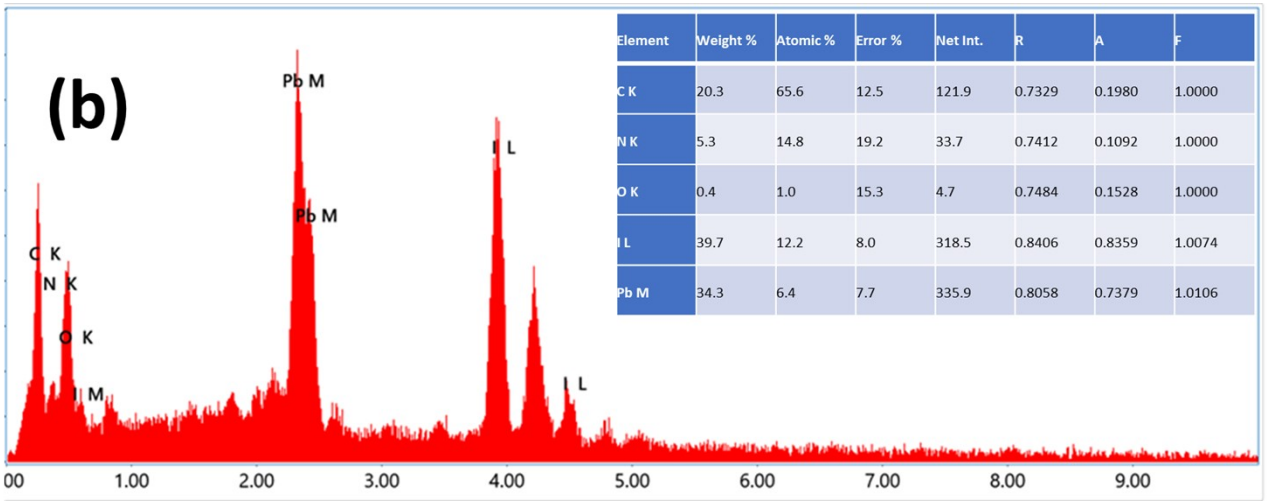
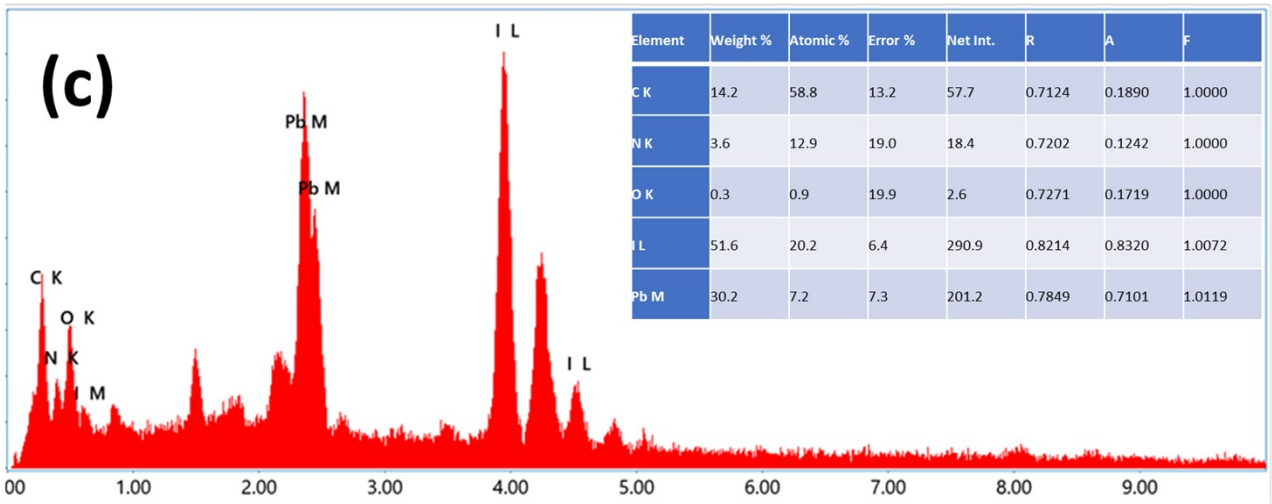


Element	Weight %	Atomic %	Error %	Net Int.	R	A	F
C K	19.6	64.3	12.1	80.3	0.7340	0.1964	1.0000
N K	5.6	15.8	18.1	24.9	0.7423	0.1111	1.0000
I L	46.5	14.5	6.6	258.2	0.8416	0.8431	1.0072
Pb M	28.3	5.4	7.3	187.5	0.8069	0.7262	1.0117



Element	Weight %	Atomic %	Error %	Net Int.	R	A	F
C K	20.3	65.6	12.5	121.9	0.7329	0.1980	1.0000
N K	5.3	14.8	19.2	33.7	0.7412	0.1092	1.0000
O K	0.4	1.0	15.3	4.7	0.7484	0.1528	1.0000
I L	39.7	12.2	8.0	318.5	0.8406	0.8359	1.0074
Pb M	34.3	6.4	7.7	335.9	0.8058	0.7379	1.0106



Element	Weight %	Atomic %	Error %	Net Int.	R	A	F
C K	14.2	58.8	13.2	57.7	0.7124	0.1890	1.0000
N K	3.6	12.9	19.0	18.4	0.7202	0.1242	1.0000
O K	0.3	0.9	19.9	2.6	0.7271	0.1719	1.0000
I L	51.6	20.2	6.4	290.9	0.8214	0.8320	1.0072
Pb M	30.2	7.2	7.3	201.2	0.7849	0.7101	1.0119

Figure S1. EDAX value of (a) $MAPbI_3$ (b) $MAPbI_3$@1rGO (c) $MAPbI_3$@5rGO

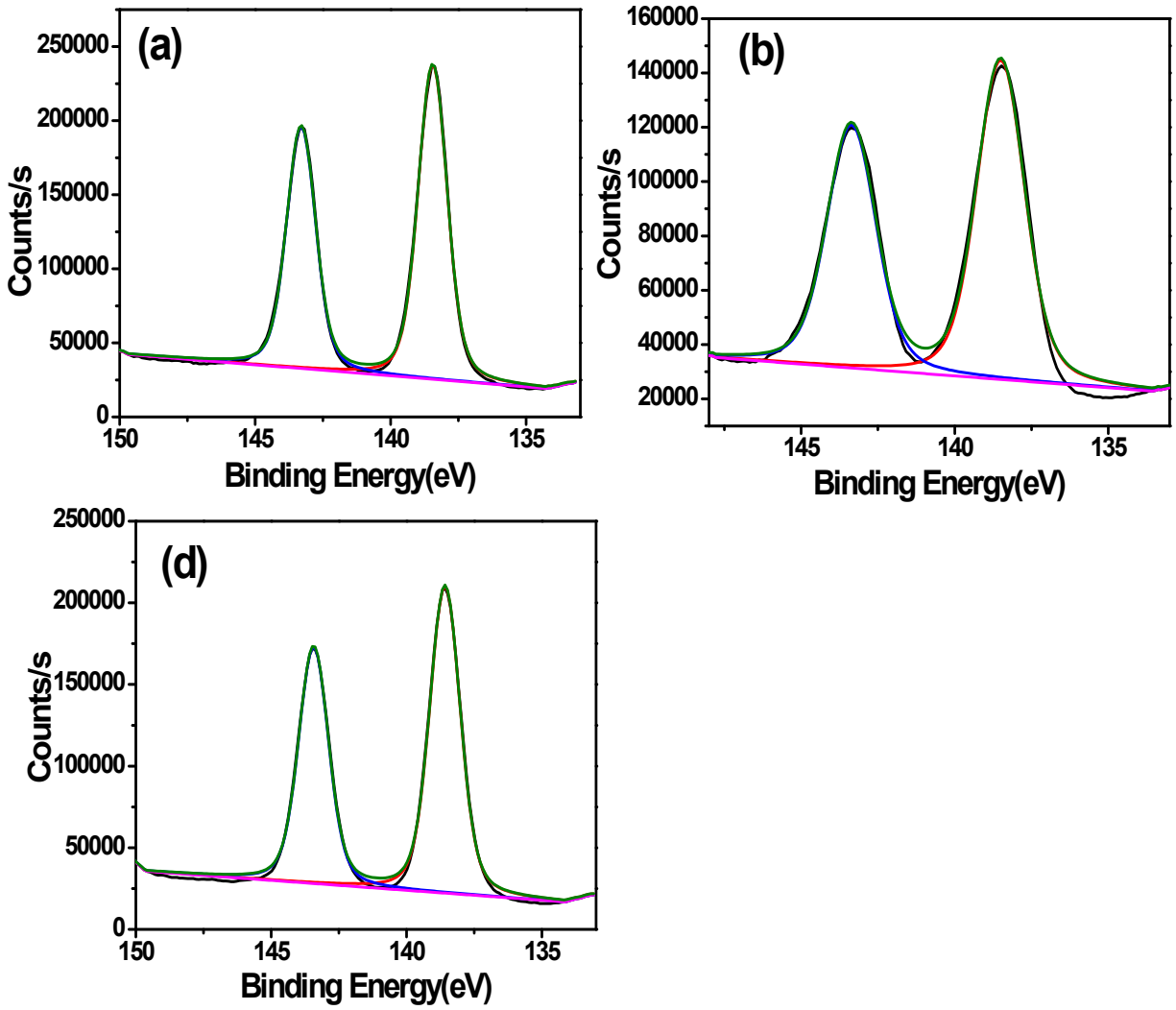


Figure S2. high-resolution Pb 1s peaks and fitting curves of (a) $MAPbI_3$@1rGO (b) $MAPbI_3$@5rGO, (c) $MAPbI_3$@7rGO

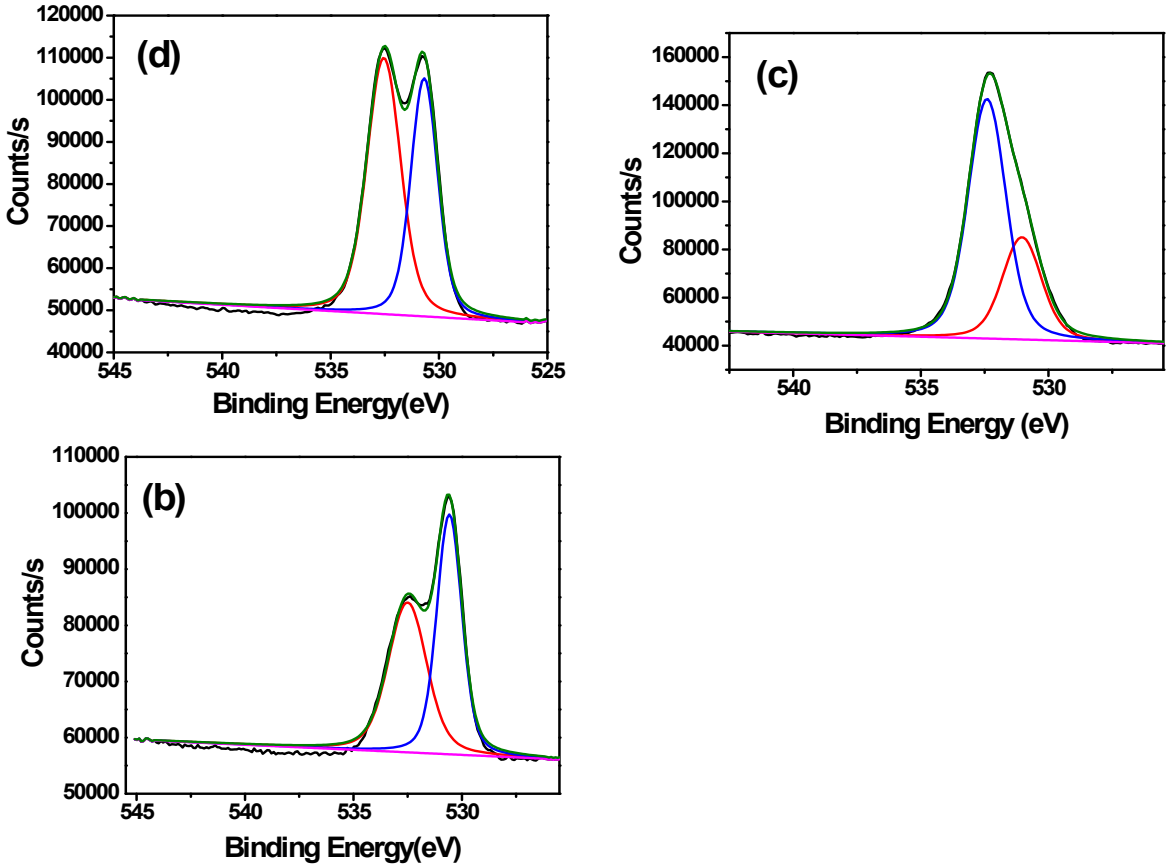
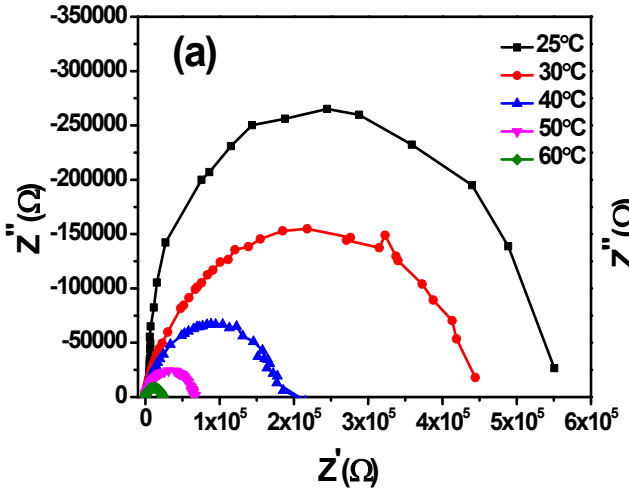
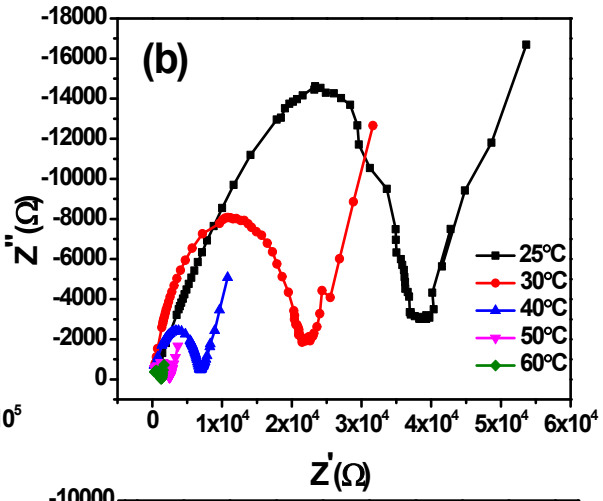


Figure S3. High-resolution O 1s peaks and fitting curves of (a) $MAPbI_3$@1rGO, (b) $MAPbI_3$@5rGO, (c) $MAPbI_3$@7rGO


(a)
25°C
30°C
40°C
50°C
60°C
-350000
-300000
-250000
-200000
-150000
-100000
-50000
0
Z''(Ω)
0
1x10^5
2x10^5
3x10^5
4x10^5
5x10^5
6x10^5
Z'(Ω)


(b)
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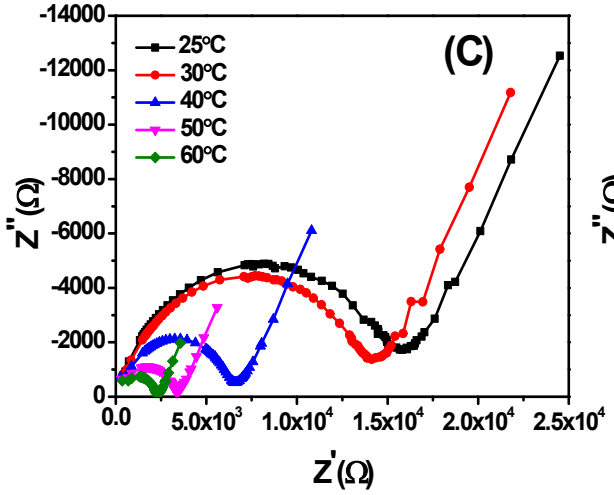
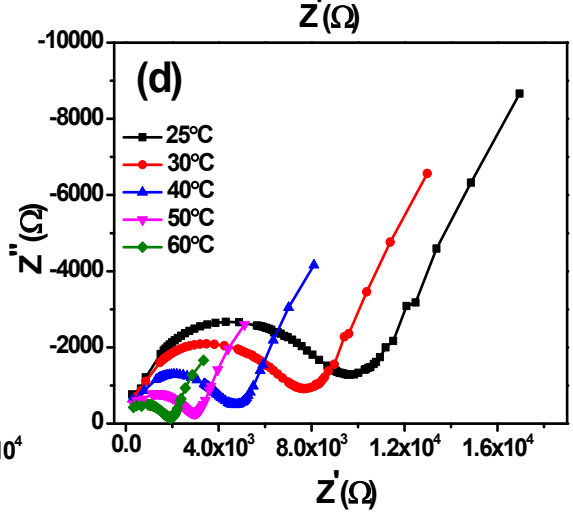
30°C
40°C
50°C
60°C
-18000
-16000
-14000
-12000
-10000
-8000
-6000
-4000
-2000
0
Z''(Ω)
0
1x10^4
2x10^4
3x10^4
4x10^4
5x10^4
6x10^4
Z'(Ω)


(C)
25°C
30°C
40°C
50°C
60°C
-14000
-12000
-10000
-8000
-6000
-4000
-2000
0
Z''(Ω)
0.0
5.0x10^3
1.0x10^4
1.5x10^4
2.0x10^4
2.5x10^4
Z'(Ω)


(d)
25°C
30°C
40°C
50°C
60°C
-10000
-8000
-6000
-4000
-2000
0
Z''(Ω)
0.0
4.0x10^3
8.0x10^3
1.2x10^4
1.6x10^4
Z'(Ω)

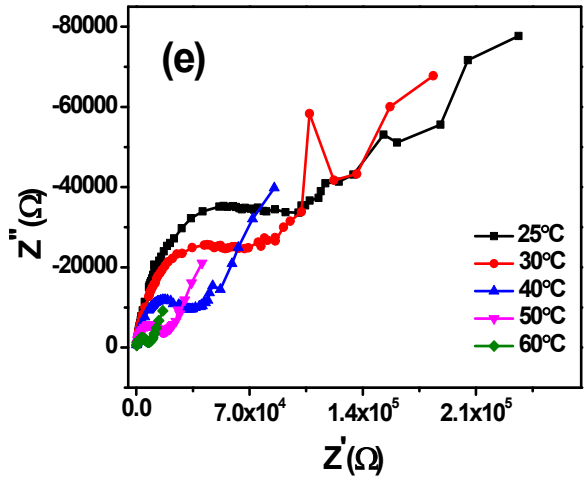

(e)
25°C
30°C
40°C
50°C
60°C
-80000
-60000
-40000
-20000
0
Z''(Ω)
0.0
7.0x10^4
1.4x10^5
2.1x10^5
Z'(Ω)

Figure S4. Variation of real parts of impedance versus imaginary parts of impedance of (a) $MAPbI_3$ (b) $MAPbI_3$@0.5rGO (c) $MAPbI_3$@1rGO (d) $MAPbI_3$@5rGO (e) $MAPbI_3$@7rGO at different temperature.

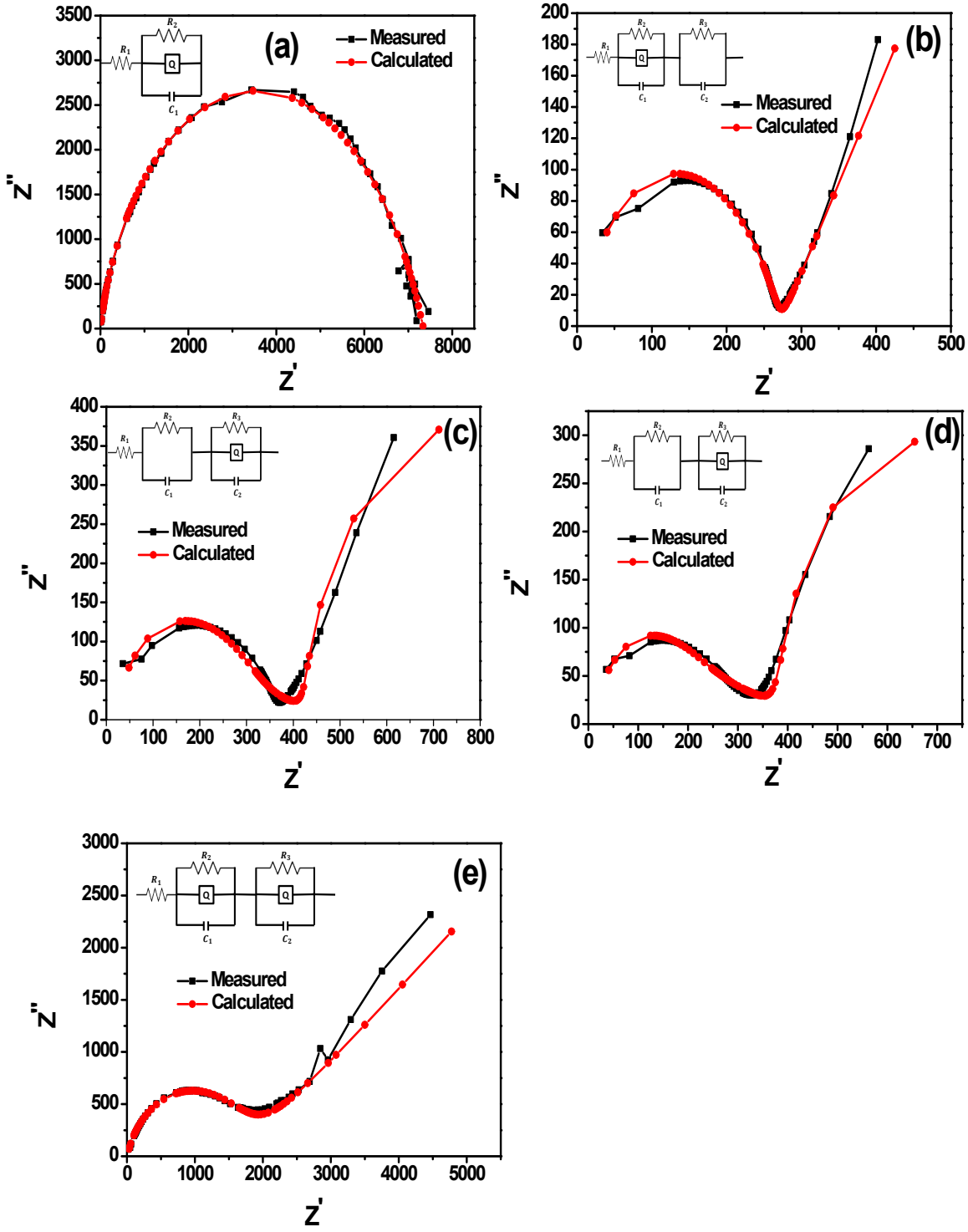


Figure S5. Variation of real parts of impedance verses imaginary parts of impedance of (a) $MAPbI_3$ (b) $MAPbI_3$@0.5rGO (c) $MAPbI_3$@1rGO (d) $MAPbI_3$@5rGO (e) $MAPbI_3$@7rGO at high temperature at 50^0C

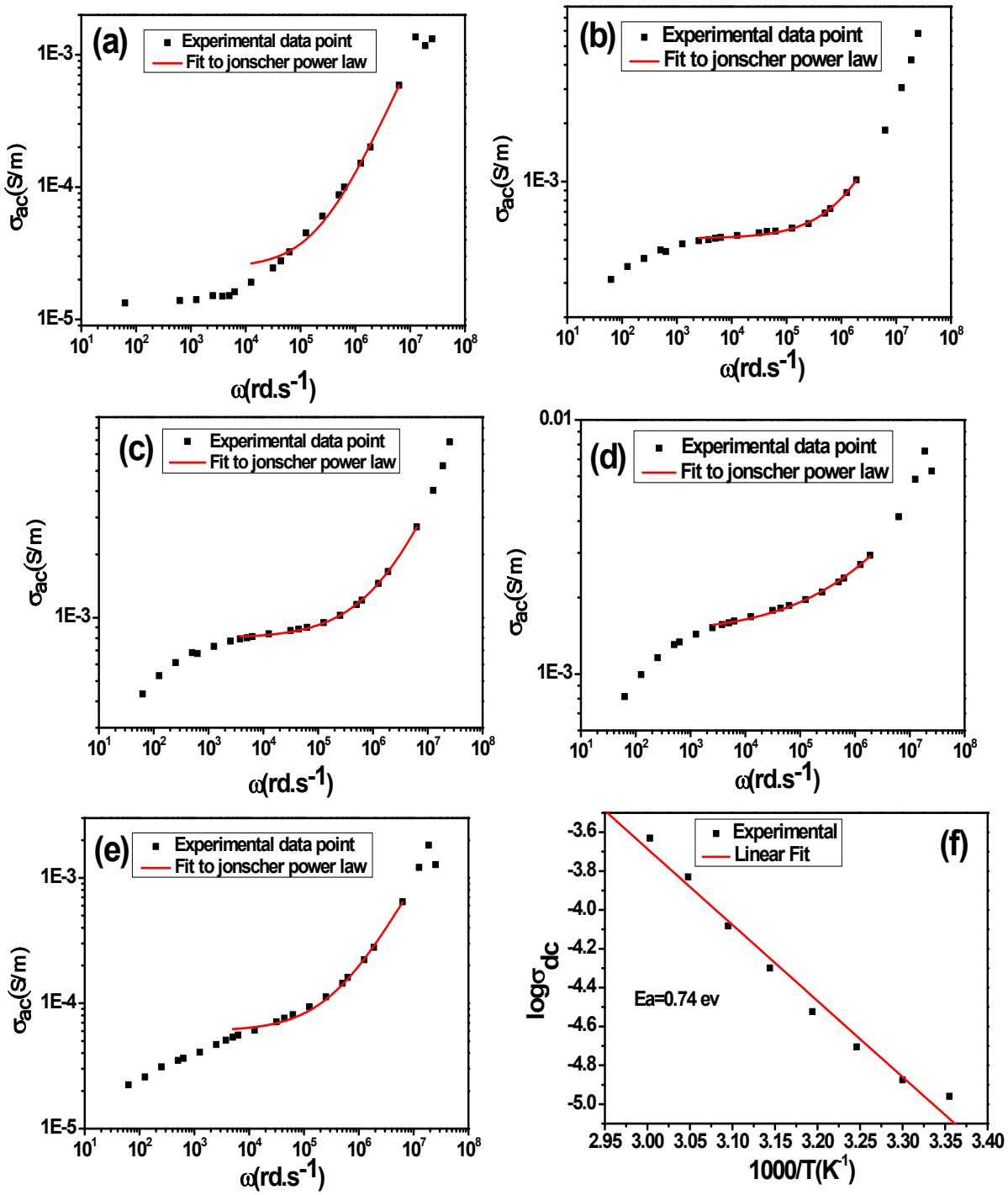


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Figure S6. Jonscher's power law fitting of ac conductivity as a function of the frequency of (a) $MAPbI_3$ (b)$MAPbI_3$@rGO (c)$MAPbI_3$@rGO (d)$MAPbI_3$@rGO (e)$MAPbI_3$@rGO (g) Linear fitting between the logarithm of dc conductivity and 1000/T(inverse of kelvin).

Table T1. Exponent ('n') value and Activation energy from Jonscher's power law of parent and composite material

Sample	'n' values	Activation Energy(eV)	Relaxation Time for complex part of impedance (micro sec)
$MAPbI_3$	0.91	0.74	318.3
$MAPbI_3$@0.5rGO	0.77	0.81	2.65
$MAPbI_3$@1rGO	0.65	0.47	1.98
$MAPbI_3$@5rGO	0.38	0.41	0.79
$MAPbI_3$@@7rGO	0.78	0.63	15.9

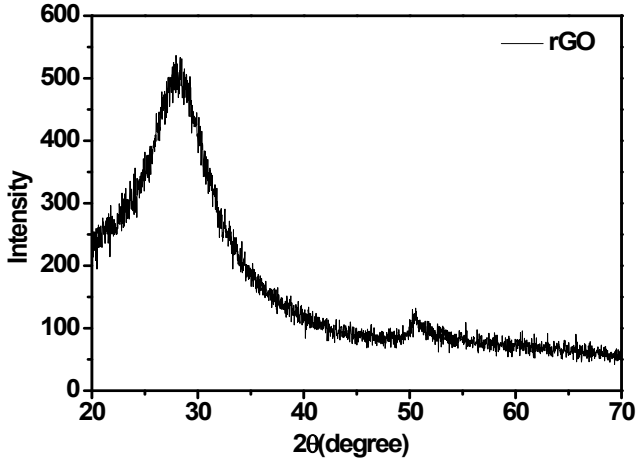

Figure S7 : XRD pattern of reduced graphene oxide

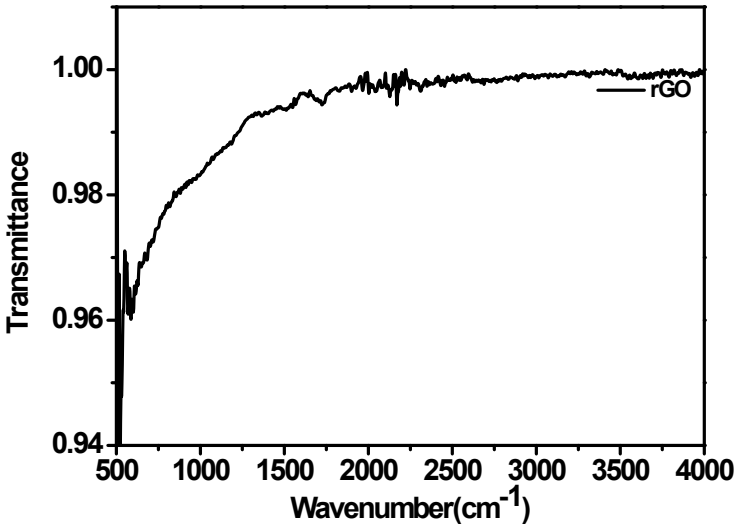

Figure S8 : FTIR Spectroscopy of reduced graphene oxide

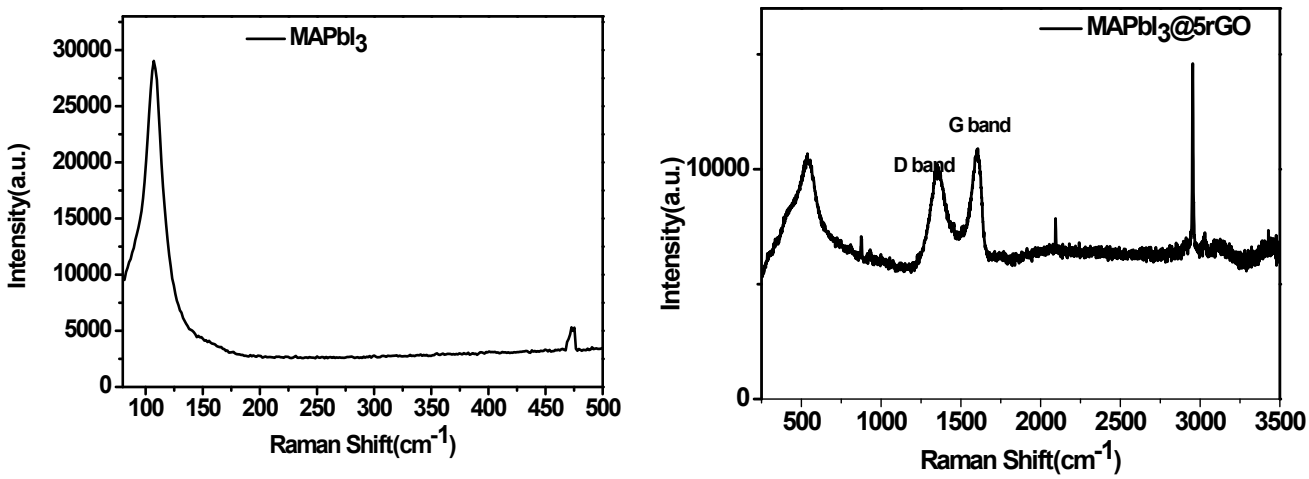

Figure S9. Raman Spectroscopy of $MAPbI_3$ and $MAPbI_3$@5rGO

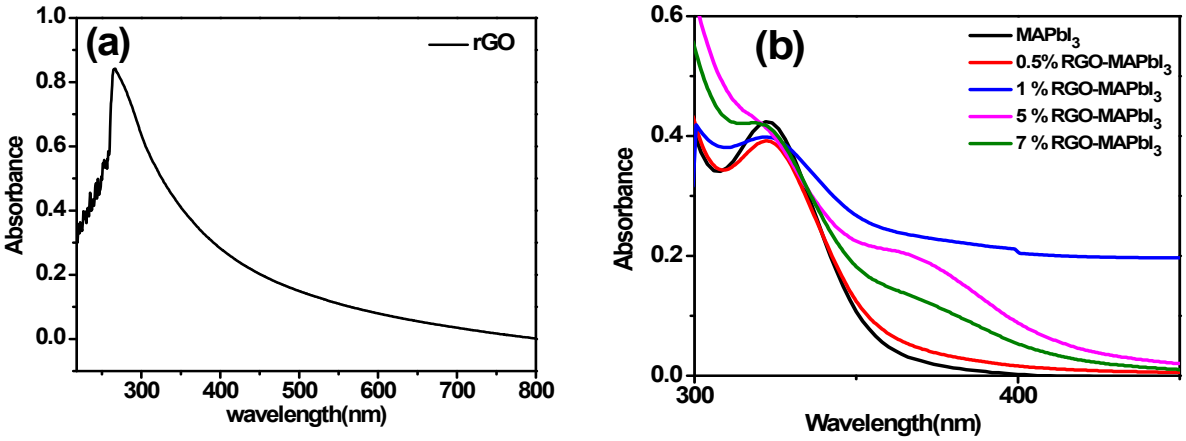

Figure S10. UV Visible spectroscopy of rGO and $MAPbI_3$@rGO composites

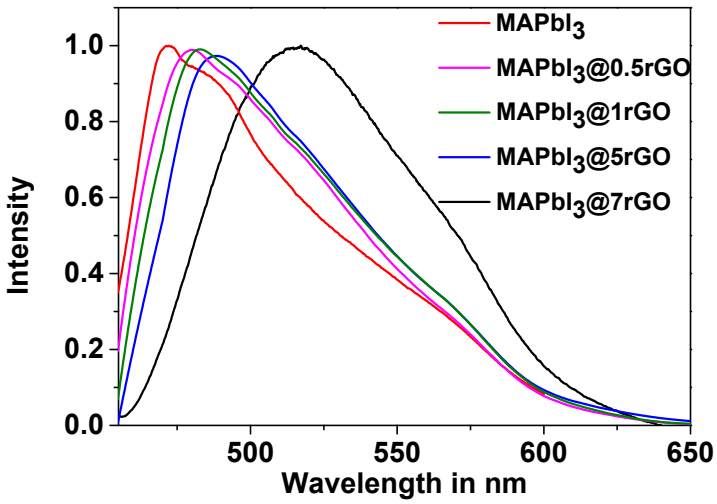

Figure S11. Emission spectra of $MAPbI_3$ and $MAPbI_3$@rGO composites