

## **Electronic Supplementary Materials**

# **Simple and Efficient Synthesis of Ruthenium(III) PEDOT:PSS Complexes for High-performance Stretchable and Transparent Supercapacitors**

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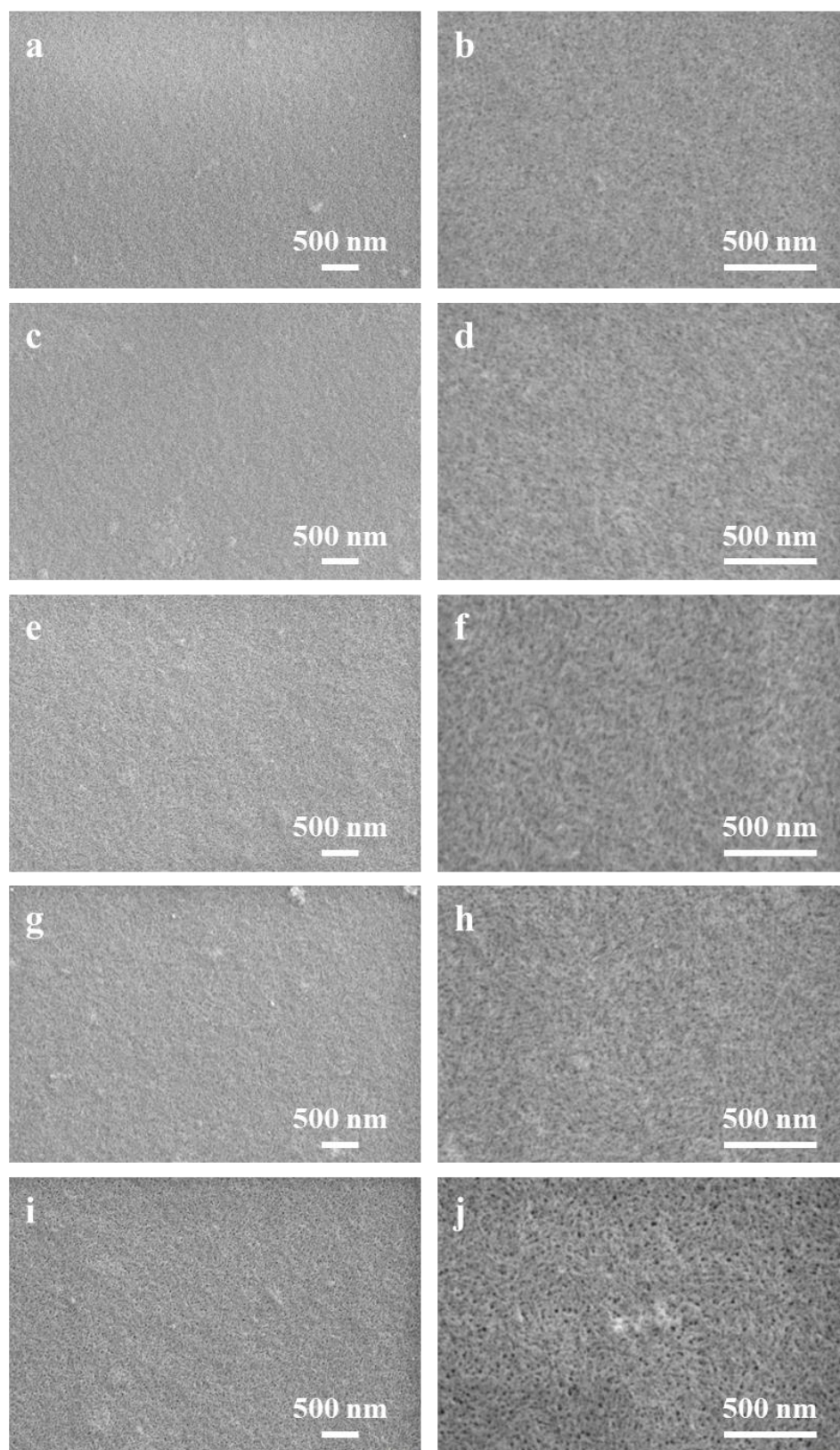
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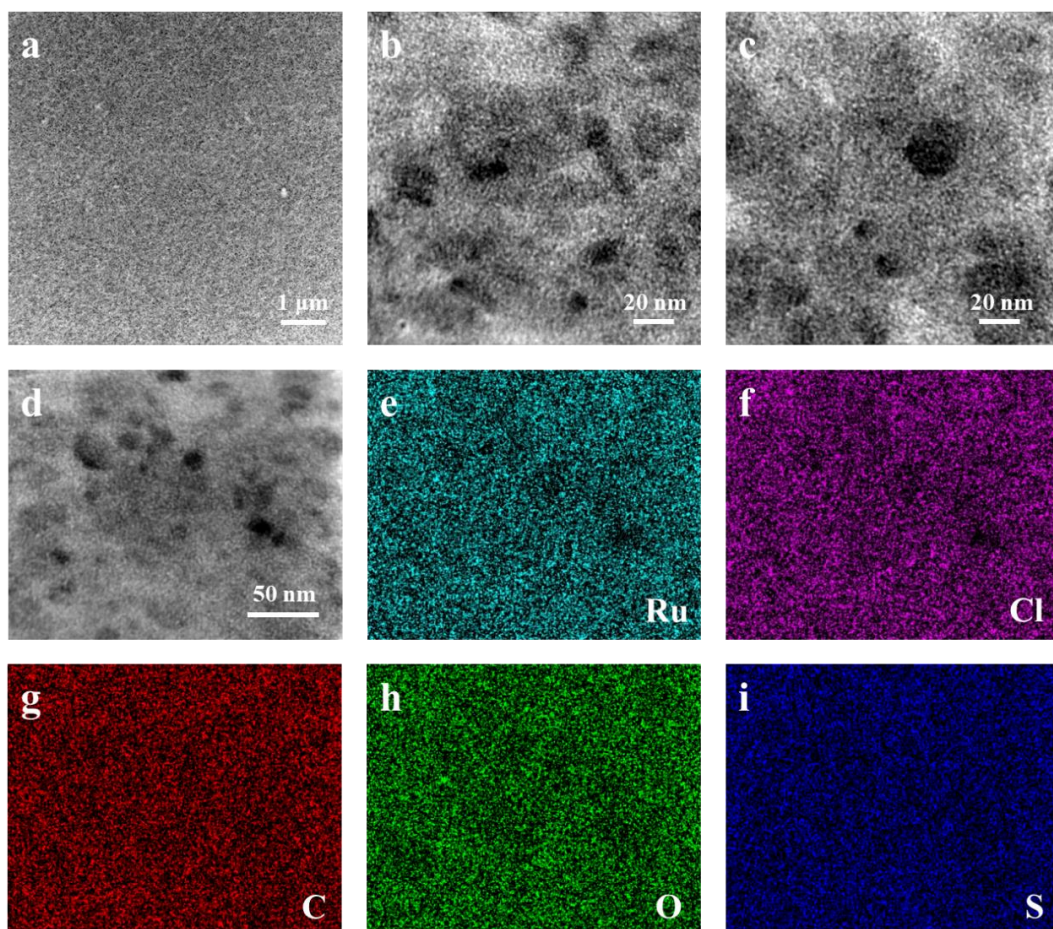
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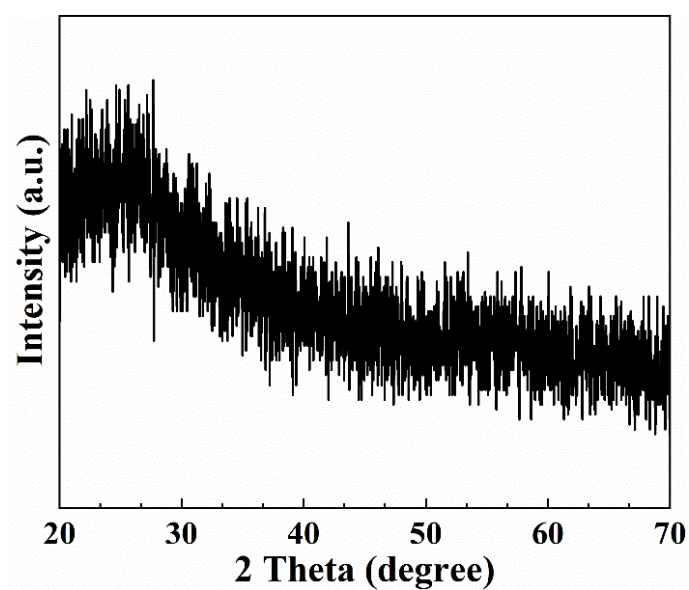
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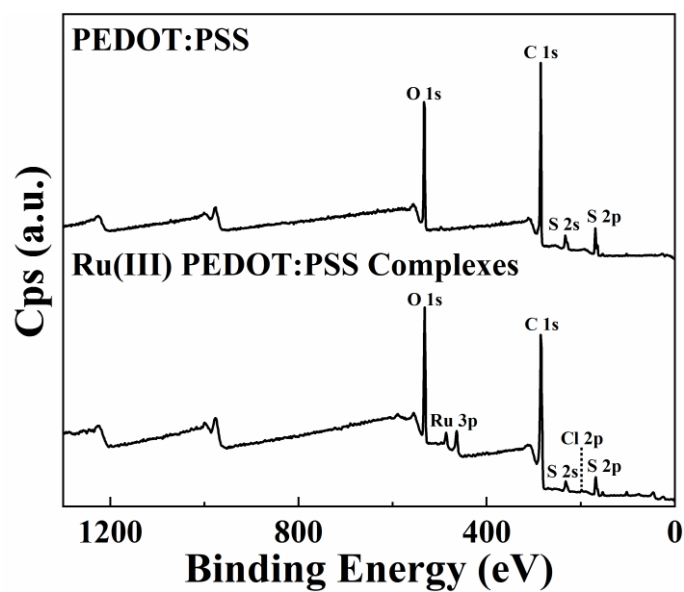
**Figure S1.** SEM images of the PEDOT:PSS film and Ru(III) PEDOT:PSS complexes films with different dipping time. (a) and (b) PEDOT:PSS film. (c) and (d) Dipping 10 s. (e) and (f) Dipping 20 s. (g) and (h) Dipping 30 s. (i) and (j) Dipping 60 s.



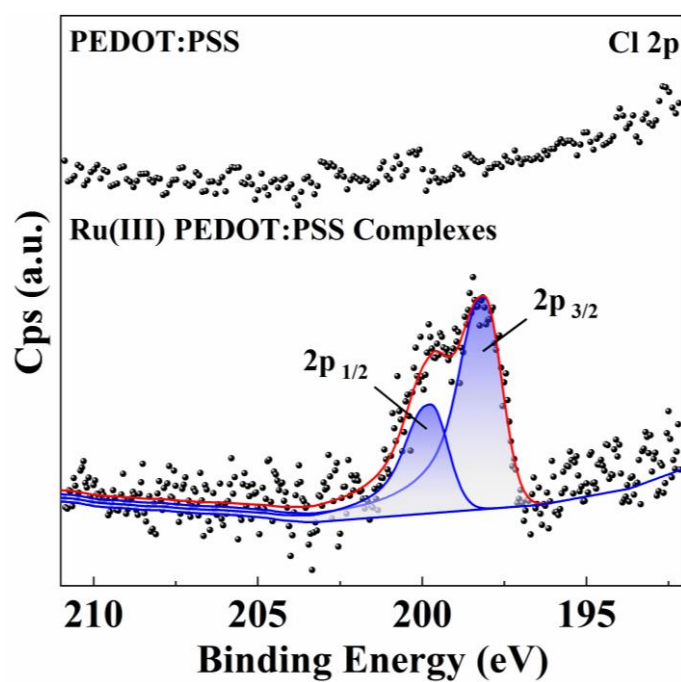
**Figure S2.** (a) TEM and (b, c) HRTEM images of Ru(III) PEDOT:PSS complexes film. (d) HAADF image of Ru(III) PEDOT:PSS complexes and corresponding element mappings of (e) Ru, (f) Cl, (g) C, (h) O and (i) S elements.



**Figure S3.** XRD pattern of Ru(III) PEDOT:PSS complexes film.

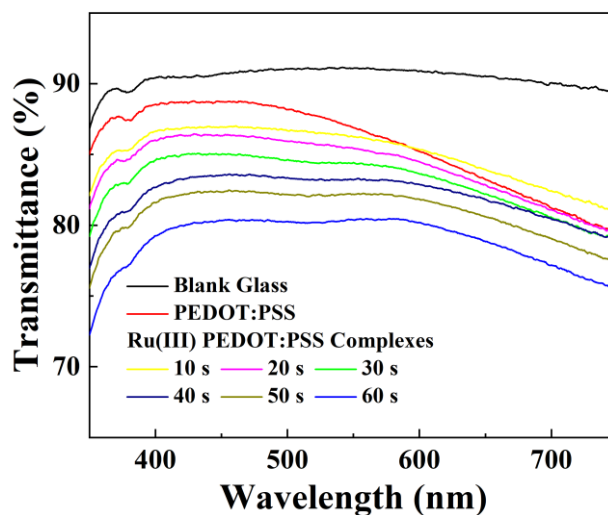


**Figure S4.** XPS survey spectra of PEDOT:PSS and Ru(III) PEDOT:PSS complexes films.

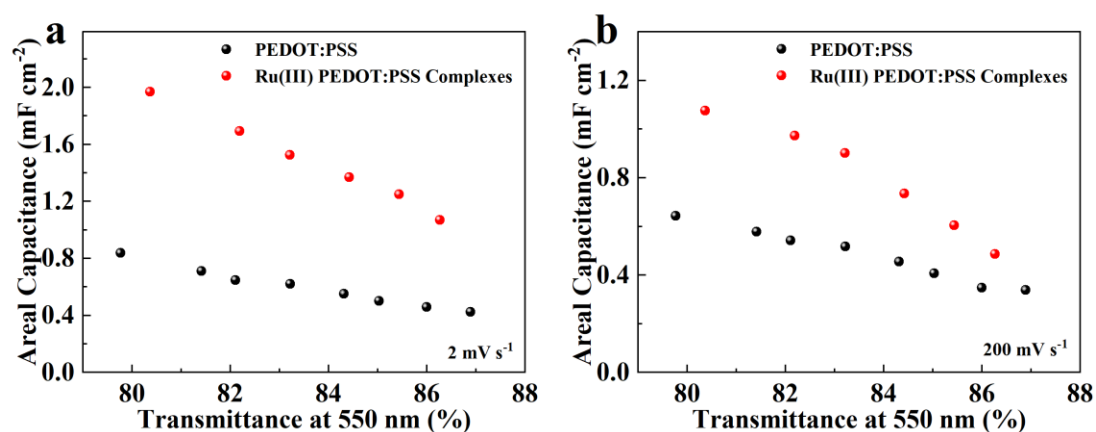


**Figure S5.** XPS Cl 2p spectra of PEDOT:PSS and Ru(III) PEDOT:PSS complexes films.





**Figure S6.** Transmittance spectra (350-750 nm) of the blank glass, PEDOT:PSS electrode and Ru(III) PEDOT:PSS complexes electrodes with different dipping time from 10 to 60 s, using air as the reference.



**Figure S7.** The plot of areal capacitance as a function of the electrode transmittance at 550 nm (using air as the reference). (a) Scan rate =  $2 \text{ mV s}^{-1}$ . (b) Scan rate =  $200 \text{ mV s}^{-1}$ .

**Table S1.** FTIR peak assignment corresponding to the PEDOT:PSS and Ru(III) PEDOT:PSS complexes .

Peaks [ $\text{cm}^{-1}$ ]	Corresponding bonds	Ref.
1551 and 1531	Asymmetric C=C stretching within the thiophene ring, PEDOT	[1, 2]
1415	Symmetric C=C stretching, PEDOT	[1]
1371	C–C stretching within the thiophene ring, PEDOT	[1, 2]
1261 and 1130	Symmetric C–O–C stretching, PEDOT	[1-3]
1057	Asymmetric C–O–C stretching, PEDOT	[2]
924	Deformation of the ethylenedioxy group in the molecule, PEDOT	[3]
943 and 856	C–S stretching, PEDOT	[2, 3]
1601, 1497, 1453	Symmetric C=C stretching, PSS	[2-4]
1159 and 1119	Asymmetric $\text{SO}_3$ stretching, PSS	[1, 2, 4]
1036 and 1009	Symmetric $\text{SO}_3$ stretching, PSS	[2, 4]
776, 708, 676	C–H out-of-plane deformation, PSS	[4]
618	Ring in-plane deformation, PSS	[4]

**Table S2.** Raman peak assignment corresponding to the PEDOT:PSS and Ru(III) PEDOT:PSS complexes.

Peaks [cm <sup>-1</sup> ]	Corresponding bonds	Ref.
439		[5-7]
579 and 990	oxyethylene ring deformation, PEDOT	[5-7]
704	symmetric C–S–C deformation, PEDOT	[5-7]
853	C–H bending, PEDOT	[7]
1120	C–O–C deformation, PEDOT	[5-7]
1258	C <sub>α</sub> –C <sub>α'</sub> inter-ring stretching, PEDOT	[5-7]
1367	C <sub>β</sub> –C <sub>β</sub> stretching, PEDOT	[5-7]
1434 and 1449	C <sub>α</sub> =C <sub>β</sub> symmetrical stretching, PEDOT	[5-7]
1496	C <sub>α</sub> =C <sub>β</sub> asymmetrical stretching, PEDOT	[5, 6]
1567	C <sub>α</sub> =C <sub>β</sub> antisymmetrical stretching, PEDOT	[6, 7]

**Table S3.** Energy density and power density of transparent supercapacitor devices in Figure 7f.

Materials	Power Density	Energy Density	Ref.
	[ $\mu\text{W cm}^{-2}$ ]	[ $\mu\text{Wh cm}^{-2}$ ]	
Ru(III) PEDOT:PSS complexes	2.60	0.58	This work
	6.01	0.53	
	11.33	0.50	
	21.21	0.47	
	47.82	0.43	
	86.83	0.39	
	151.35	0.34	
PEDOT:PSS	1.02	0.226	This work
	2.44	0.217	
	4.80	0.213	
	9.38	0.208	
	22.81	0.203	
	44.72	0.199	
	84.65	0.188	
RuO <sub>2</sub> /PEDOT:PSS	8.27	0.053	[8]
	16.14	0.052	
	30.88	0.051	
	66.01	0.045	
	108.68	0.037	
	136.66	0.030	
	151.31	0.026	
Ni <sub>3</sub> (HITP) <sub>2</sub>	1.35	0.12	[9]
	2.33	0.12	
	4.65	0.12	
	9.34	0.11	



	13.98	0.11	
	23.46	0.11	
	32.84	0.11	
	46.71	0.10	
	69.39	0.09	
Cu <sub>3</sub> (HHTP) <sub>2</sub>	4.5	0.088	[10]
	9.3	0.084	
	14.1	0.081	
	23.3	0.077	
	32.9	0.073	
	46.6	0.068	
	70.2	0.066	
	93.1	0.060	
Covalent Organic Frameworks	0.75	0.027	[11]
	1.32	0.027	
	1.95	0.026	
	2.65	0.025	
	3.96	0.023	
	5.25	0.022	
	7.95	0.020	
	13.13	0.016	
	18.02	0.011	
	24.42	0.009	
Ti <sub>3</sub> C <sub>2</sub> T <sub>x</sub> MXene	0.5682	0.00947	[12]
	1.1244	0.00937	
	2.733	0.00911	
	5.244	0.00874	
	9.792	0.00816	

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