

Supplementary Material

Ultrafast Fabrication of H_2SO_4 , LiCl , and Li_2SO_4 Gel Electrolyte Supercapacitors with Reduced Graphene Oxide (rGO)- LiMnO_x Electrodes Processed Using Atmospheric-Pressure Plasma Jet

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Supplementary Information

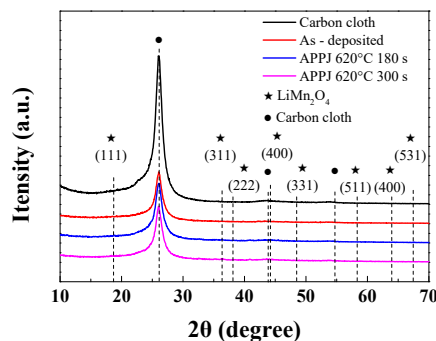


Figure S1. XRD patterns of rGO- LiMnO_x on carbon cloth.

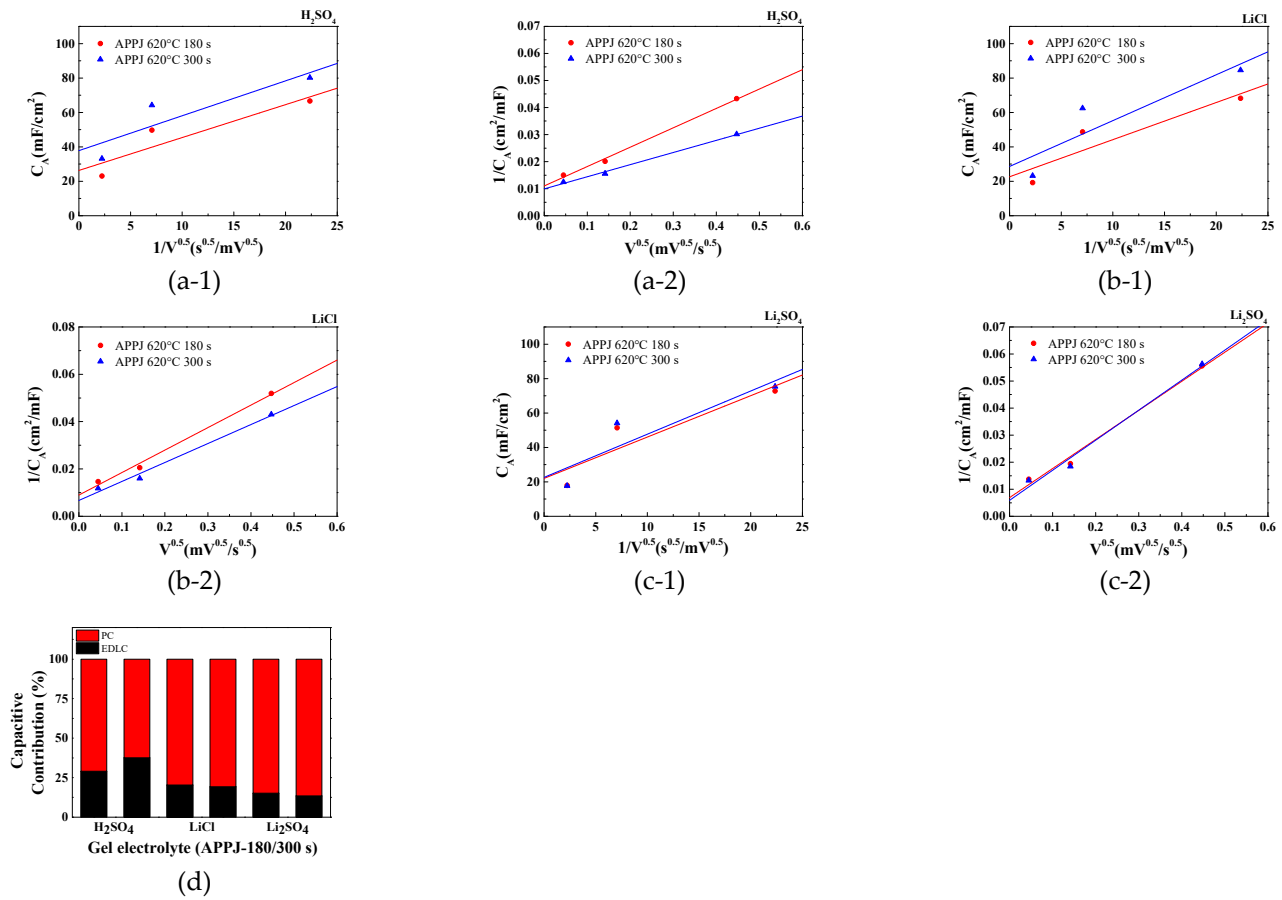


Figure S2. Trasatti plots generated for HSCs using 1 M (a) H₂SO₄, (b) LiCl, and (c) Li₂SO₄ gel electrolytes. Plots of (a-1, b-1, c-1) C_A vs. $1/v^{0.5}$ and (a-2, b-2, c-2) $1/C_A$ vs. $v^{0.5}$. (d) Capacitance contributions ratio of PC/EDLC.

Table S1. Capacitance contributions of HSCs.

		C_{total} (mF/cm ²)	C_{out} (mF/cm ²)	C_{in} (mF/cm ²)	Capacitive Contribution (EDLC:PC) (%)
H ₂ SO ₄	APPJ - 180 s	90.74	26.32	64.42	29.0:71.0
	APPJ - 300 s	100.70	37.82	62.88	37.6:62.4
LiCl	APPJ - 180 s	111.48	22.65	88.83	20.3:79.7
	APPJ - 300 s	149.03	28.64	120.39	19.2:80.8
Li ₂ SO ₄	APPJ - 180 s	144.51	22.03	122.48	15.2:84.8
	APPJ - 300 s	169.20	22.62	146.58	13.4:86.6

Table S2. Advantages of the work compared to reported electrolyte supercapacitors.

Advantages	Description
Novel material combination	By screen-printing pastes containing rGO and LiCl-Mn(NO ₃) ₂ ·4H ₂ O onto carbon cloth substrate with nitrogen APPJ processing, a novel material combination with superior performance is introduced.
Potential advantages of choosing different gel electrolytes	The interaction between gel electrolyte and electrode materials leads to higher energy storage and faster energy release, resulting in superior energy density

	and power density compared to reported supercapacitors.
Stability	Nitrogen APPJ treatment enhances interface stability between materials, thereby extending the operational lifespan of the supercapacitor.

Table S3. Comparison of electrochemical properties of rGO-LiMnO_x/ rGO-MnO_x based supercapacitors.

Electrode materials	Electrolyte	Performance	Cycling stability	Reference
Carbon cloth/ rGO-LiMnO _x	PVA/ 1M H ₂ SO ₄	57.76 mF/cm ²	82.10% after 20 mV/s for 1000 cycles	This work
Carbon cloth/ rGO-LiMnO _x	PVA/ 1M LiCl	59.95 mF/cm ²	76.09% after 20 mV/s for 1000 cycles	This work
Carbon cloth/ rGO-LiMnO _x	PVA/ 1M Li ₂ SO ₄	86.42 mF/cm ²	76.86% after 20 mV/s for 100 cycles	This work
Aluminum foil/ rGO-LiMnO ₂	1M LiPF ₆	185.60 mAh g ⁻¹	80.97% after 100 cycles	[1]
Aluminum foil/ LiMnO ₂	1M LiPF ₆	140.8 mAh g ⁻¹	53.53% after 100 cycles	[1]
RGO wrapped LiMn ₂ O ₄ nano-rods	1M LiPF ₆	143.5 mAh g ⁻¹	97% after 50 cycles	[2]
Carbon cloth/ rGO-MnO _x	PVA/ 1M H ₂ SO ₄	57.01 mF/cm ²	84.41% after 200 mV/s for 10,000 cycles	[3]
Carbon cloth/ LiMn ₂ O ₄	1M Li ₂ SO ₄	78.46 mC cm ⁻²	104.53% after 20 mV/s for 1000 cycles	[4]
Nickel foam/ rGO-Mn ₃ O ₄	1M Na ₂ SO ₄	457 F g ⁻¹	91.60% after 5000 cycles	[5]
Nickel foam/ rGO-MnO _x	1M Na ₂ SO ₄	214 F g ⁻¹	N/A	[6]
defect induced rGO-MnO _x	1M Na ₂ SO ₄	264 F g ⁻¹	153% after 10000 cycles	[7]
Nickel foam/ rGO-MnO _x /Mn ₃ O ₄	0.5M Na ₂ SO ₄	442 F g ⁻¹	N/A	[8]

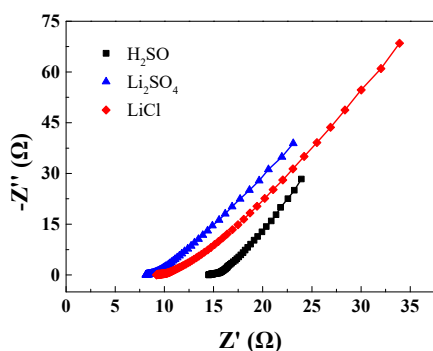


Figure S3. Comparison of EIS results for H₂SO₄, LiCl, and Li₂SO₄ gel electrolyte HSCs treated with APPJ for 300 s.

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