Electronic Supplementary Material (ESI) for RSC Advances.

Synthesis and electrical properties of hybrid gel Electrolytes derived from Keggin-type heteropoly acids and 3-(pyridin-1-ium-1-yl) propane-1-sulfonate (PyPs)

Sumaletha Narayanan, Xia Tong and Venkataraman Thangadurai*

Department of Chemistry, University of Calgary, 2500 University Dr NW, Calgary, Alberta, T2N 1N4
*For correspondence (vthangad@ucalgary.ca) Phone: 1 403 210 8649

Supporting Information

Table S1. CHN elemental analysis PyPs and its hybrid compounds, PyPs-H_3PWMo, PyPs-H_4PMoV, and PyPs-H_5PMoV.

		Theoretical	Experimental
PyPs	% C	47.75	47.09
	% H	5.51	5.65
	% N	6.96	6.67
PyPs-H_3PWMo	% C	8.23	8.31
	% H	1.3	1.32
	% N	1.2	1.14
PyPs-H_4PMoV	% C	14.38	14.45
	% H	2.04	1.82
	% N	2.10	2.01
PyPs -H_5PMoV	% C	17.54	18.17
	% H	2.02	2.64
	% N	2.56	2.64

Table S2. The impedance fitting results of PyPs-H4PMoV and PyPs-H5PMoV hybrids at different temperatures.

Sample	**T (ºC)**	**R_1 (MΩ)**	**R_b (MΩ)**	**CPE_b (F)**	**C_b (F)**	**CPE_{el} (F)**	**χ^2 (10^{-4})**
PyPs-H_4PMoV	32	12.6	93.9	6.68×10^{-11}	5.12×10^{-12}	6.69×10^{-5}	3
	67	4.45	0.96	4.63×10^{-9}	1.70×10^{-10}	4.32×10^{-4}	2
PyPs-H_5PMoV	60	10.1	518	7.19×10^{-11}	3.36×10^{-12}	1.56×10^{-5}	8

Supporting Figures

Fig. S1. Photographs of heteropoly acid (a) $H_4PMo_{11}VO_{40}$ and (b) its hybrid form, PyPs-H_4PMoV derived from HPA and PyPs ionic liquid.

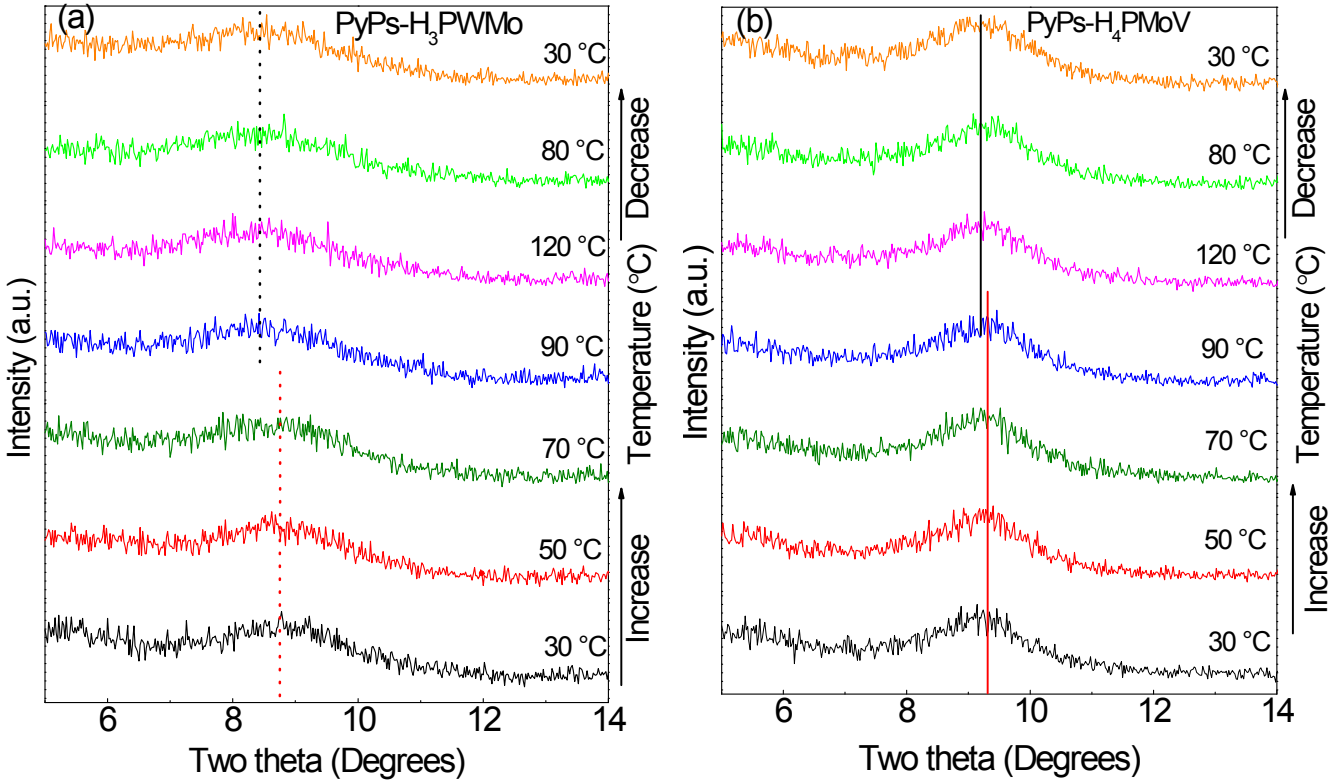
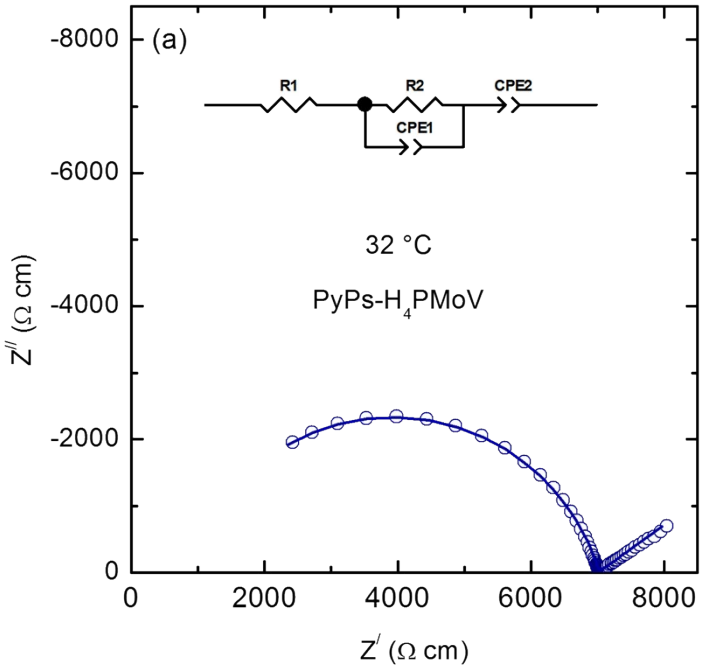
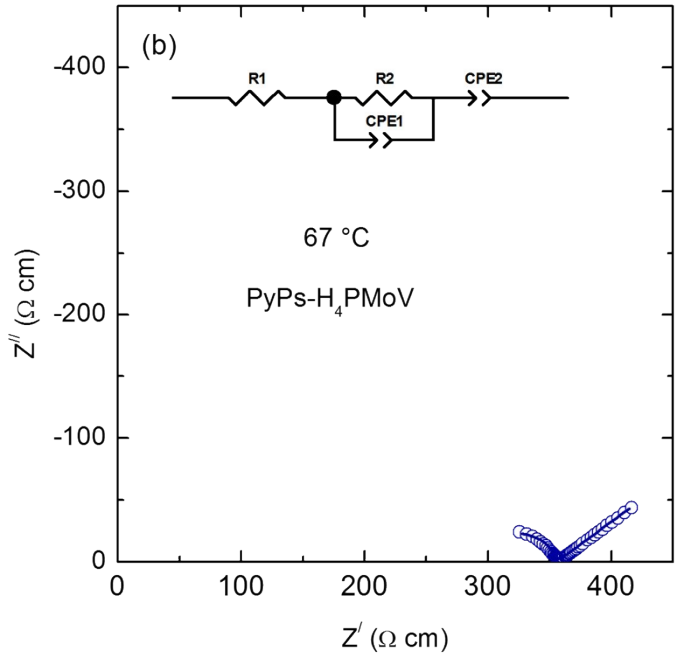


Fig. S2. HTXRD patterns of (a) PyPs-H_3PWMo and (b) PyPs-H_4PMoV under different temperature.


(a)
R1
R2
CPE2
CPE1
32 °C
PyPs-H4PMoV
-8000
-6000
-4000
-2000
0
0
2000
4000
6000
8000
Z// (Ω cm)
Z/ (Ω cm)


(b)
R1
R2
CPE2
CPE1
67 °C
PyPs-H4PMoV
-400
-300
-200
-100
0
0
100
200
300
400
Z// (Ω cm)
Z/ (Ω cm)

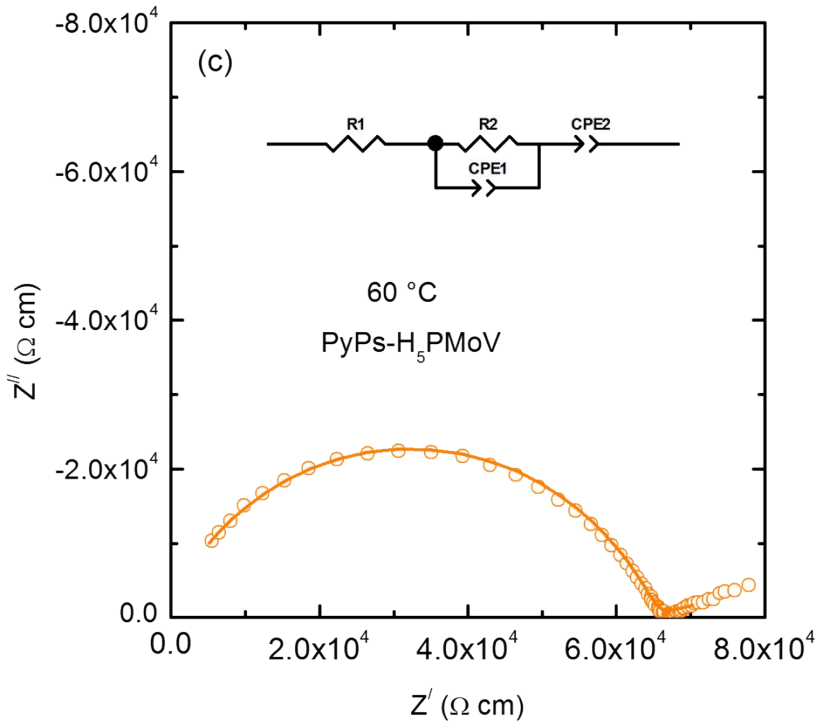


Fig. S3. Typical ac impedance spectra of PyPs-POM hybrids**,** (a) PyPs-H_4PMoV at 32 °C, (b) PyPs-H_4PMoV at 67 °C, and (c) PyPs-H_5PMoV at 60 °C measured in air atmosphere.