Supplementary Information for

A new nanocomposite polymer electrolyte based on Poly(vinyl alcohol) incorporating hypergrafted nano-silica

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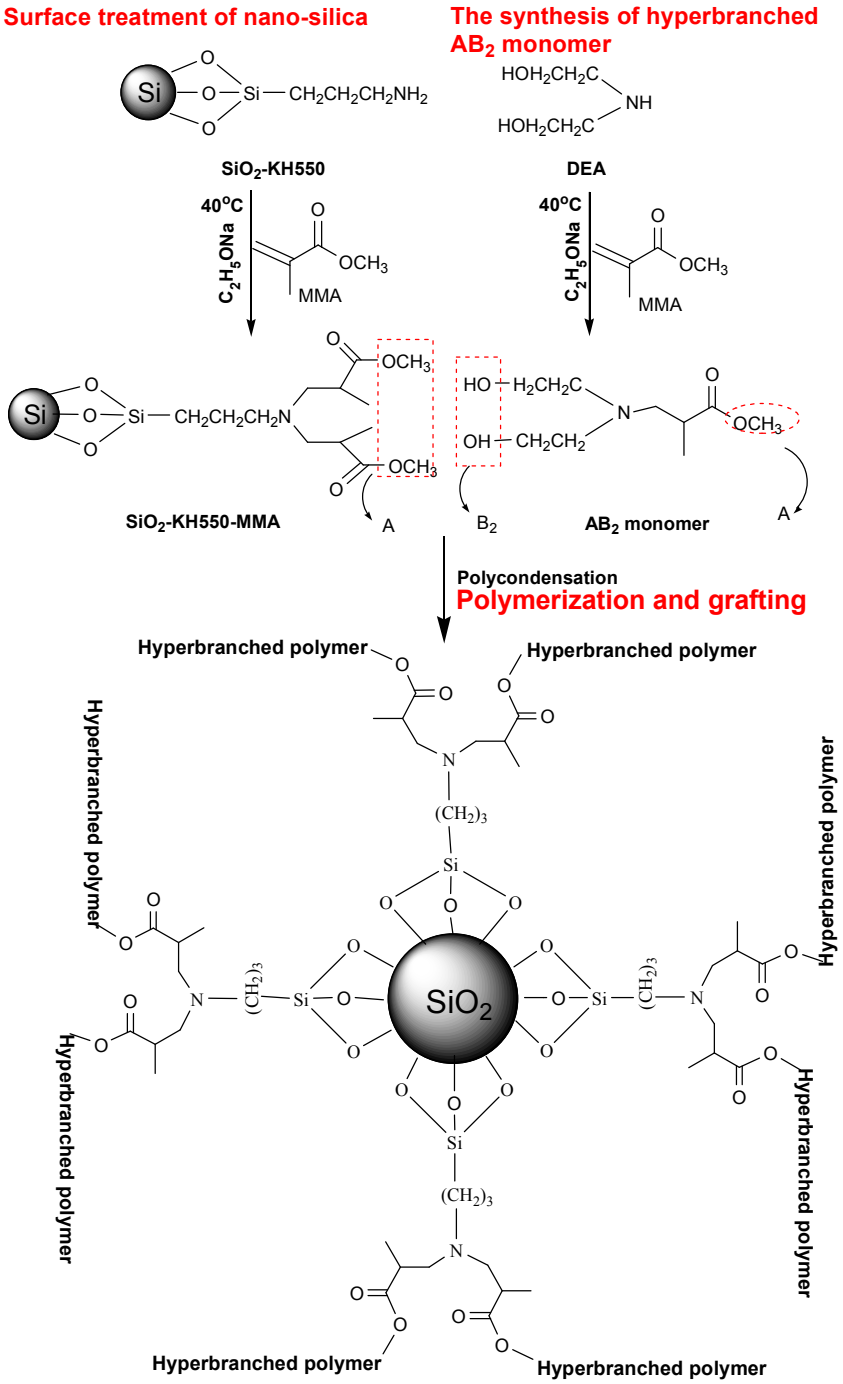
Experimental process



Scheme.S1 The illustration of the synthesis process

The TGA analysis

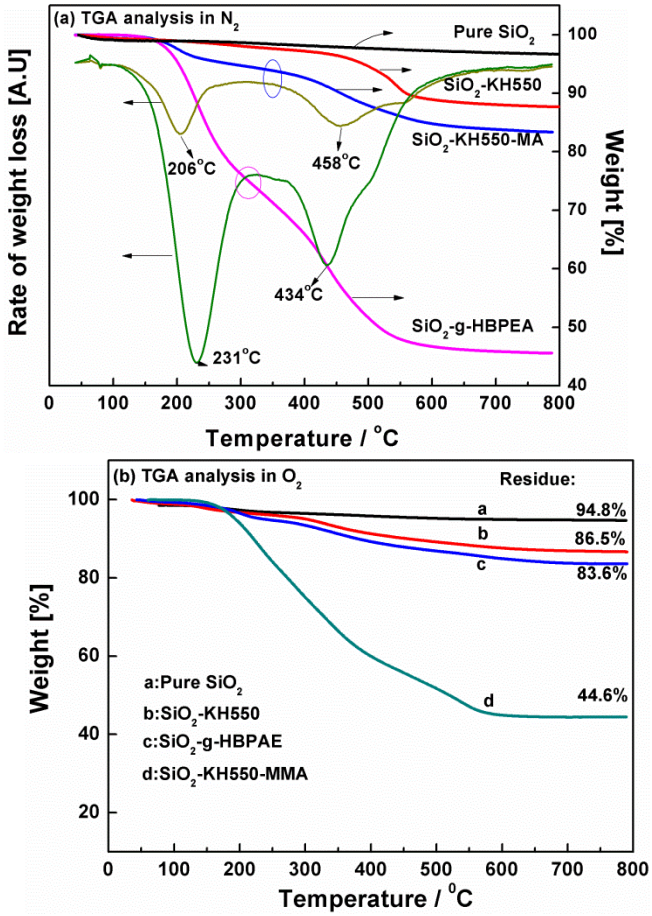


Fig.S1 TGA spectrum of SiO_2、SiO_2-KH550、SiO_2-KH550-MMA and SiO_2-g-HBPAE

Tab. S1 Thermal decomposition temperatures from the TGA test of nano-silica

Samples	Initial decomposition temperature (ºC)	Peak decomposition temperature (ºC)	Final decomposition temperature (ºC)	Grafting ratio (%)
SiO_2	-	-	-	**0**
SiO_2-KH550	395	543	681	**9.6**
SiO_2-KH550-MMA$_{(first)}$	161	206	261	**13.4**
SiO_2-KH550-MMA$_{(second)}$	362	458	526	
SiO_2-g-HBPAE$_{(first)}$	181	231	322	**112.6**
SiO_2-g-HBPAE$_{(second)}$	368	434	492	

First represents the First decomposition Peak

Second represents the Second decomposition Peak

The grafting ratio is calculate from the curves in Fig.S1(b)

The Mass spectrum of AB_2 monomer

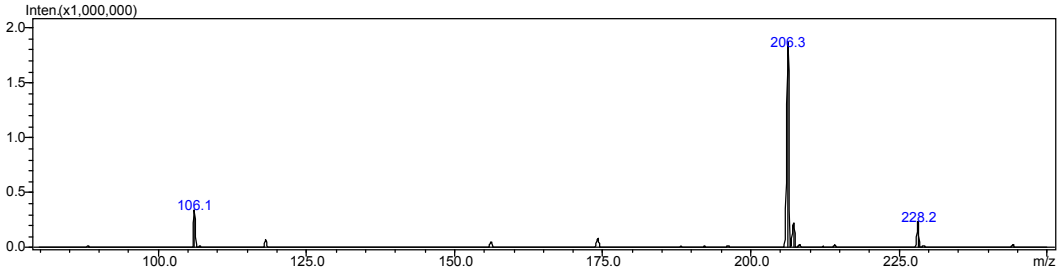


Fig.S2 The Mass Spectrometry of AB_2 monomer

The calculation of Degree of branching (DB)[1-2]

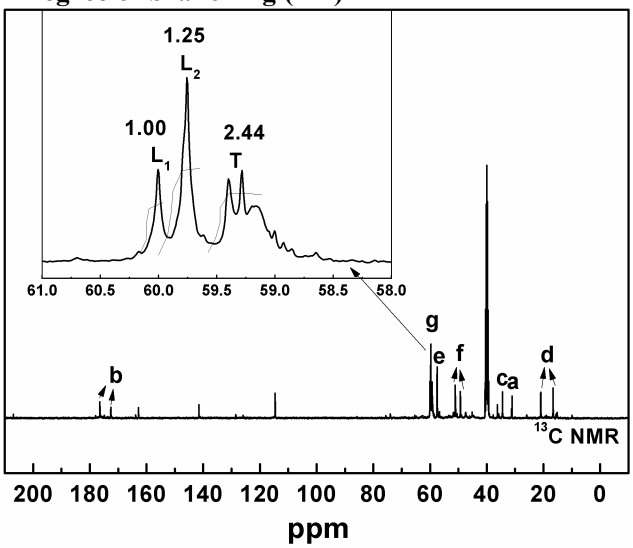


Fig.S3 The assignment of linear and terminal units of HBPAE in ^{13}C NMR

$$DB = \frac{D+T}{D+T+L} = \frac{T-1+T}{T-1+T+L} \approx \frac{2T}{2T+L} = \frac{1}{1+\frac{L}{2T}} \quad \text{Equation.S1}$$

$$= \frac{1}{1+\frac{1.00+1.25}{2*2.44}} = 0.68 \quad \text{Equation.S1}$$

Tab.S2 The content of element on the surface of nano-silica before and after hypergrafting

Samples	Si	O	C	N
SiO_2-KH550-MMA (Before grafting)	21.53%	48.35%	26.20%	3.06%
SiO_2-KH550-MMA-g-HBPAE (After grafting)	20.60%	38.91%	35.14%	5.35%

DSC characterization

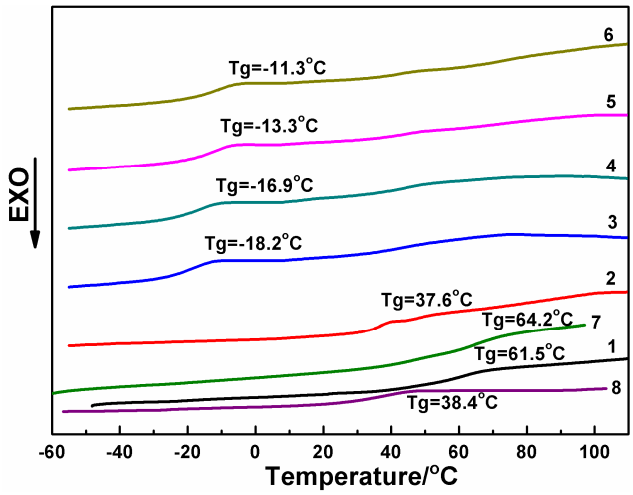


Fig.S4 The DSC characterization of Pure PVA and SiO_2-g-HBPAE /PVA/$LiClO_4$:
（1）Pure PVA；（2）PVA/30wt %$LiClO_4$；（3） 5wt%SiO_2-g-HBPAE /PVA；
（4）10wt%SiO_2-g-HBPAE /PVA（5）15wt%SiO_2-g-HBPAE /PVA
（6）30wt%SiO_2-g-HBPAE /PVA; (7) 5wt%SiO_2/PVA; (8) HBPAE（3）～（6）all doped with 30wt %$LiClO_4$

The morphology of fracture surface of PVA matrices

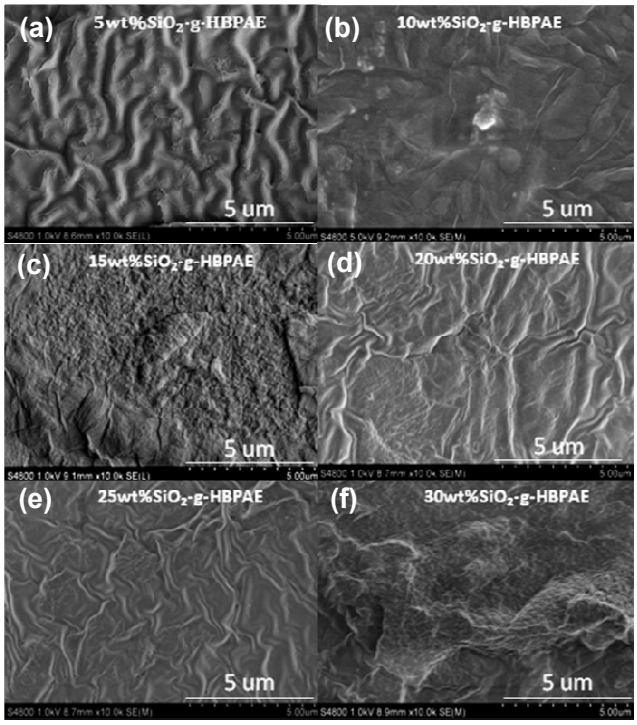


Fig. S5 SEM images of SiO_2-g-HBPAE/PVA composite polyelectrolyte at different loading of nano-silica at a fixed content of 30wt% $LiClO_4$

The tensile properties of CPEs with high $LiClO_4$ doping content with various SiO_2-g-HBPAE loading

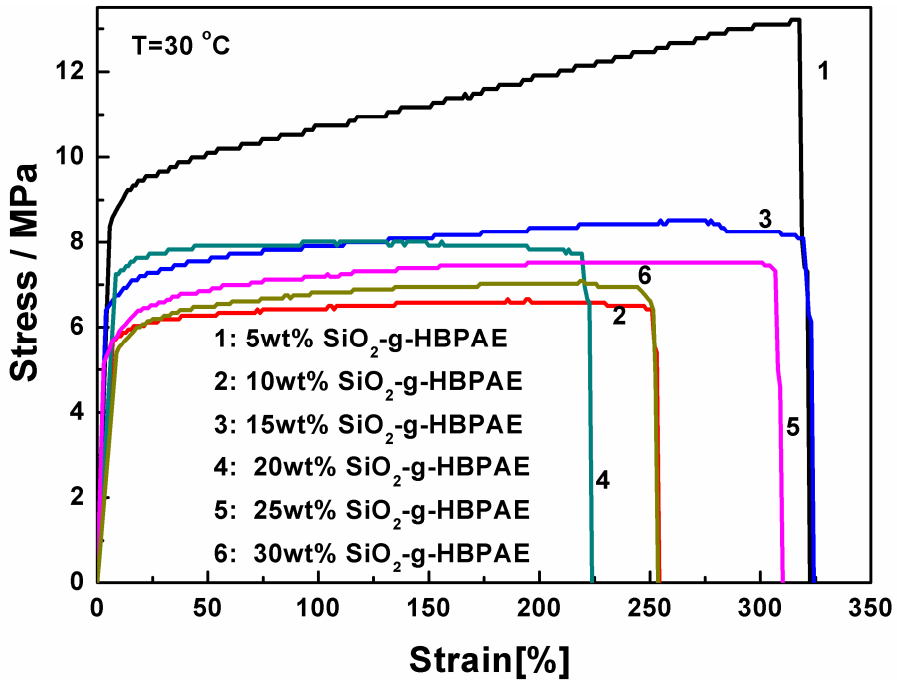


Fig.S6 Typical tensile stress-strain curves of composite polymer electrolytes measured at 30℃ with different SiO_2-g-HBPAE loading at a fixed content of 54wt% $LiClO_4$。

References

1 C. J. Hawker, R. Lee and J. M. J. Frechet, *J Am. Chem. Soc.,* 1991, **113**, 4583.

2 C. Gao and D. Yan, *Prog. Polym. Sci.,* 2004, **29**, 183.