Supporting Information

Facile synthesis of recyclable Zn(II)-metallosupramolecular polymers and the visual detection of tensile strength and glass transition temperature

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Table of contents

1. General remarks S3

2. Synthesis of linear polymer PESpys.....S3-4

3. The molecular weights of PESpys S4

4. The structure characterization of PESpys S4

5. Preparation of PESpys and PESpys-Zn^{2+} films S5

6. The characterization of PESpy-5% and PESpy-5%-Zn^{2+} films.....S6

7. Solubility of the PESpys and PESpys-Zn^{2+} films S6

8. The thermal stability and the mechanical strength of the polymers……S7

1. General remarks

2,6-Bis(2-benzimidazolyl)pyridine and bisphenol-A were purchased from TCI Development Co., Ltd., 4,4'-difluorodiphenyl sulphone was purchased from J & K Technology Co., Ltd., and was further purified by recrystallization from alcohol twice before use. The rest of materials and reagents were obtained from different commercial sources and used without further purification. FTIR spectra were recorded on a Nicolt 6700 FTIR spectrometer. ^{1}H NMR spectra were performed on Bruker AV-400 spectrometer at 400 MHz in DMSO-d_6 (δ 2.50 ppm). The glass transition temperature was obtained by differential scanning calorimetry (DSC) curve at a rate of 10 ^{o}C/min under flowing nitrogen gas. The thermogravimetric analysis (TGA) was performed on a Setarma TG-92 at a heating rate of 10 ^{o}C/min under nitrogen atmosphere. The stress-strain experiments were carried out on a universal testing machine (WDW-100, Changchun research institute of testing machines, China) at a strain rate of 2 mm/min and a temperature of 25 °C. The EDS experiments were conducted using a field emission SEM (JEOL JSM-7400F).

2. Synthesis of linear polymer PESpys

A typical synthetic procedure for polymer PESpy-5% is illustrated as an example. To a three-necked flask (25 mL) equipped with a magnetic stirrer, an argon outlet, inlet, and water-cooled condenser, bisphenol-A (0.2168 g, 0.95 mmol, 95%), 2,6-bis(2-benzimidazolyl)pyridine (0.0156 g, 0.05 mmol, 5%), 4,4'-difluorodiphenyl sulphone (0.2543 g, 1 mmol), K_2CO_3 (0.4146 g, 3 mmol), and N-methylpyrrolidinone (NMP, 2.0 mL) were added. The reaction mixture was evacuated and flushed with

high-purity argon. This procedure was repeated three times. The reaction mixture was heated to 140 °C under stirring for 3 h, and then the temperature was subsequently brought to 185 °C and maintained at this temperature for 6 h. The resulting polymer solution was allowed to slowly cool to room temperature, and subsequently poured into cold water, filtered, washed with water and methanol several times, and then dried at 100 °C under vacuum (94% yield). The syntheses of other PESpys were carried out in the same manner with yields all above 90%.

3. The molecular weights of PESpys

Table S1. Polymerization data for PESpys.

Copolymer	M_n	M_w	M_w/M_n	Yield (%)
PESpy-5%	142200	328482	2.31	94
PESpy-10%	130100	308337	2.37	93
PESpy-20%	118700	339482	2.86	90

4. The structure characterization of PESpys

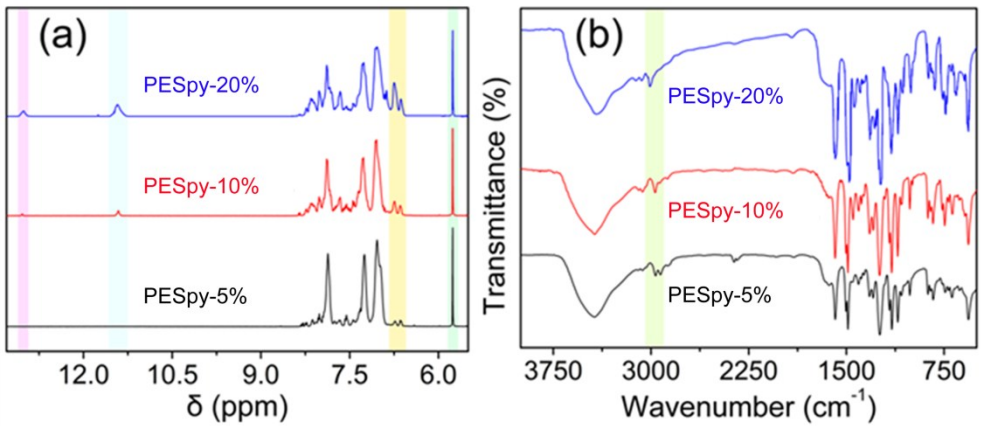

Fig. S1 ^{1}H NMR (a) and FT-IR (b) spectra of PESpys.

5. Preparation of PESpys and PESpys-Zn^{2+} films

A typical preparation procedure for PESpy-5% film is illustrated as an example. 0.0625 g polymer PESpy-5% was dissolved in 2.5 mL NMP to form a 2.5 wt% solution, the polymer solution was filtered and subsequently cast onto a clean, flat glass plate, and dried in a convection oven at 70 °C for 24h and then further dried under vacuum at 70 °C for another 24h to afford the PESpy-5% polymer film (about 17 μm thickness). Preparation of other PESpy films were carried out in the same manner.

A typical preparation procedure for PESpy-5%-Zn^{2+} film is illustrated as an example. The desired mole equivalent of the Zn^{2+} (coordination unit:Zn^{2+} = 2:1) was added into the 2.5 wt% PESpy-5% polymer solution, the solution was subsequently cast onto a clean, flat glass plate, and dried in a convection oven at 70 °C for 24h and then further dried under vacuum at 70 °C for another 24h to afford the PESpy-5%-Zn^{2+} polymer film (about 17 μm thickness). Preparation of other PESpy-Zn^{2+} films were carried out in the same manner.

6. The characterization of PESpy-5% and PESpy-5%-Zn^{2+} films

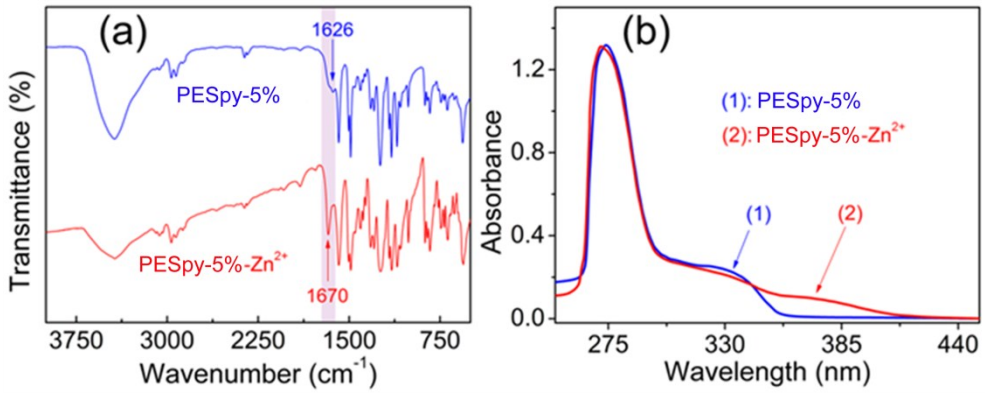

Fig. S2 (a) FT-IR spectra of PESpy-5% (blue) and PESpy-5%-Zn^{2+} (red) films. (b) The UV-vis absorption spectra of PESpy-5% (blue) and PESpy-5%-Zn^{2+} (red) films.

7. Solubility of the PESpys and PESpys-Zn^{2+} films

Table S2. Solubility of PESpys and PESpys-Zn^{2+} films.

Sample	DMAc	DMSO	DMF	NMP	THF	Chloroform
PESpy-5%	+ +	+ +	+ +	+ +	- -	+ -
PESpy-10%	+ +	+ +	+ +	+ +	- -	+ -
PESpy-20%	+ +	+ +	+ +	+ +	- -	+ -
PESpy-5%-Zn^{2+}	- -	- -	- -	- -	- -	- -
PESpy-10%-Zn^{2+}	- -	- -	- -	- -	- -	- -
PESpy-20%-Zn^{2+}	- -	- -	- -	- -	- -	- -

+ +: The polymer can be completely dissolved; + –: the polymer can only swelling but insoluble; - -: the polymer was insoluble.

8. The thermal stability and the mechanical strength of the polymers

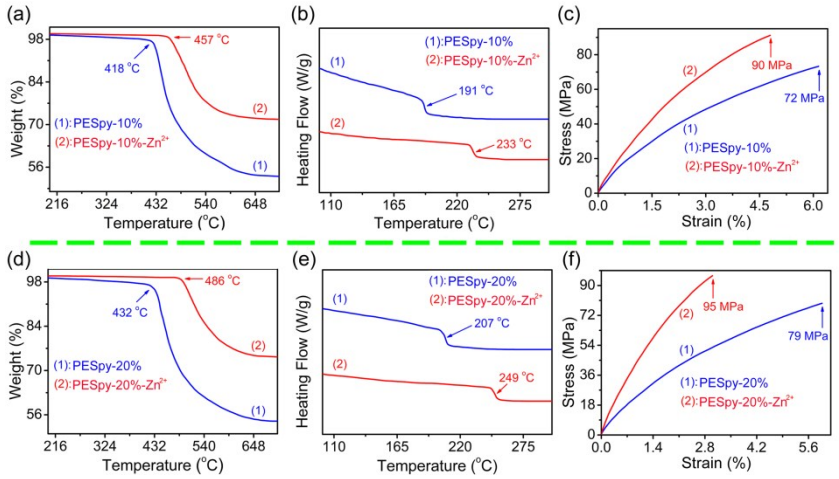

Fig. S3 TGA curves of PESpy-10% and PESpy-10%-Zn^{2+} (a), PESpy-20% and PESpy-20%-Zn^{2+} (d). DSC curves of PESpy-10% and PESpy-10%-Zn^{2+} (b), PESpy-20% and PESpy-20%-Zn^{2+} (e). Stress-strain behaviors for PESpy-10% and PESpy-10%-Zn^{2+} (c), PESpy-20% and PESpy-20%-Zn^{2+} (f).