

Electronic Supplementary Material

Lignin-based polymer with high phenolic hydroxyl group content prepared by the alkyl chain bridging method and applied as a dopant of PEDOT

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Experimental parts

1. Structural properties characterization of PLS

1.1 Phenolic hydroxyl group content measurement

The phenolic hydroxyl group (-OH) content of samples was detected by the Folin-Ciocalteu colorimetric (FC) method^[1]. The detailed procedure was also described in our previous study^[2].

1.2 ¹H-NMR Spectroscopy Analysis

The ¹H-NMR spectra of LS and PLS were recorded with 30 mg of sample dissolved in 0.5 mL of DMSO-d₆ at room temperature by a DRX-400 spectrometer (Bruker Co., Ettlingen, Germany).

1.3 TG measurement

5~10 mg samples are placed in a clean porcelain crucible, then a Q600 SDT thermal differential thermal joint analyzer (TA Corporation of the United States) was

applied to test the thermal stability of the samples. The test conditions are as follows: nitrogen was used as protective gas and blow-off gas, the flow rate is 20 mL/min, the temperature ranged from 30 to 600 °C, and the rate of heating up was 10 K/min.

1.4 Cyclic voltammetry measurement

a glassy carbon electrode was first polished carefully with alumina powder to a mirror finish surface and rinsed with distilled water repetitively. Sample solution was prepared by dissolving 10~15 mg sample in 1 mL distilled water. Then LS and PLS polymer films were deposited at the surface of the clean glassy carbon electrode. The resulting electrode was immersed in 0.1 M Bu₄NPF₆ DCM solutions, and was stabilized in 0.1 M Bu₄NPF₆ DCM solutions by scanning the potential between -0.8 and +2.0 V at a scan rate of 100 mV/s.

2. Structural properties characterization of PEDOT:PLSs

2.1 Ultraviolet visible absorption spectrum (UV) test

The UV-visible absorption spectrum of the diluted sample dispersion was analyzed by UV-2450 UV spectrophotometer. The scanning range was set from 190 to 1100 nm and the step length is 1 nm.

2.2 Infrared Spectroscopy (FTIR) test

FTIR spectra were recorded on an AutosystemXL/I-series/Spectrum2000 (Thermo Nicolet Co., Madison, WI, USA); the KBr pellet method was applied. The wavelength test ranged from 4000 to 400 cm⁻¹.

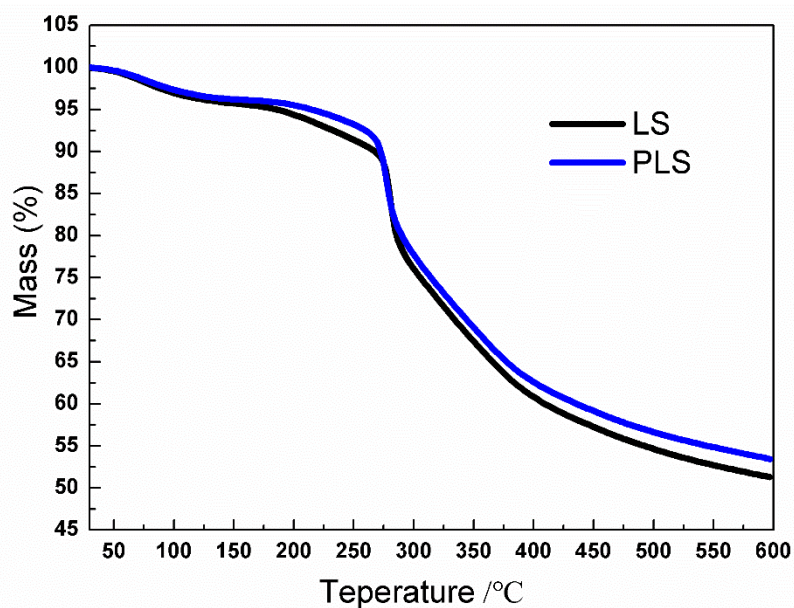


Fig.S1. Thermogravimetric curves (TGA) of straw material liginosulfonate (LS) and phenolated-liginosulfonate (PLS).

Table S1. Signal assignment for ^1H NMR spectrometry of PLS polymers

Signal (ppm)	Assignment
8.0-6.0	Aromatic H in S and G units
6.9	Aromatic H in G
6.6	Aromatic H in S
3.7-4.0	Methoxyl H
2.0-0.5	Aliphatic H

References

- [1] de Sousa F, Reimann A, Björklund Jansson M, Nilberbrant N O. Estimating the amount of phenolic hydroxyl groups in lignins. *11th ISWPC*, Nice, France, 2001, 3: 649-653
- [2] Zhou H, Yang D, Wu X. Deng Y, Qiu X. Physicochemical properties of sodium liginosulfonates (NaLS) modified by laccase. *Holzforschung*, 2012, 66: 825-832