

## Supplementary Information

### **Eco-friendly polysorbate aqueous solvents for efficient dissolution of lignin**

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#### **Materials and methods**

##### **Materials**

Kraft lignin was purchased from Sigma-Aldrich; Polysorbate (Tween-80) was purchased from Shanghai Jingchun Biotechnology Co. Ltd.. The two materials were used as received.

##### **Dissolution of lignin in the Tween-80/H<sub>2</sub>O solvent**

In a typical dissolution experiment, water, at a given mass ratio, was added to Tween-80 to gain Tween-80/H<sub>2</sub>O solvent. Lignin was added into a 20 mL colorimetric tube which contained 2.0 g of Tween-80/H<sub>2</sub>O solvent, and the tube was sealed with parafilm. The tube was then immersed in an oil bath (DF-101S, Gongyi Yingyu Instrument Factory), and the bath temperature was controlled to be  $25 \pm 0.5$  °C. The lignin/Tween-80/H<sub>2</sub>O mixture was heated and stirred at 25 °C. Additional lignin was

added until the solution became completely clear under polarization microscope (Nanjing Jiangnan Novel Optics Co. Ltd.). When lignin became saturated, judged by the fact that lignin could not be dissolved further within 1-2 h, its solubility (expressed by gram per 100g of solvent) at 25 °C could be calculated from the amount of the solvent and lignin added.

### **Measurements of UV/Vis spectra for the Tween-80/H<sub>2</sub>O/lignin solution**

Measurement of maximum absorption wavelength for lignin in Tween-80/H<sub>2</sub>O/lignin solution was recorded on a PERSEE TU-1900 UV/Vis spectrophotometer in transmission mode over a range of 190–500 nm at 25 °C.

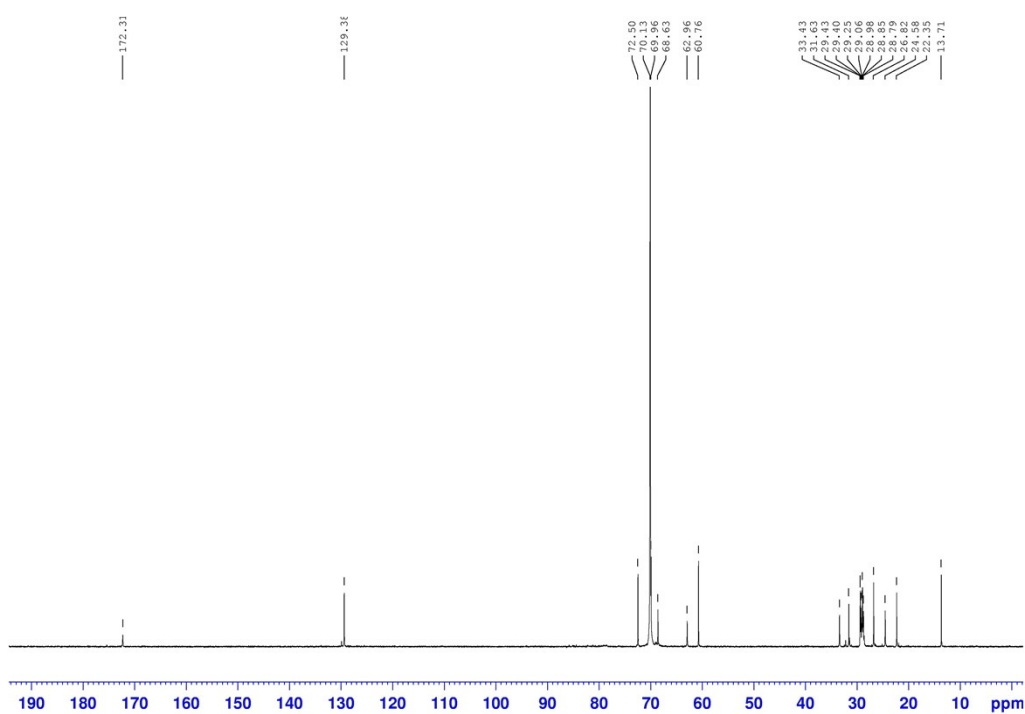
### **Characterization of the regenerated lignin**

Fourier transform infrared (FTIR) spectra were recorded on a Nicolet Nexus spectrometer with KBr pellets. A total of 16 scans were taken for each sample at a resolution of 2 cm<sup>-1</sup>.

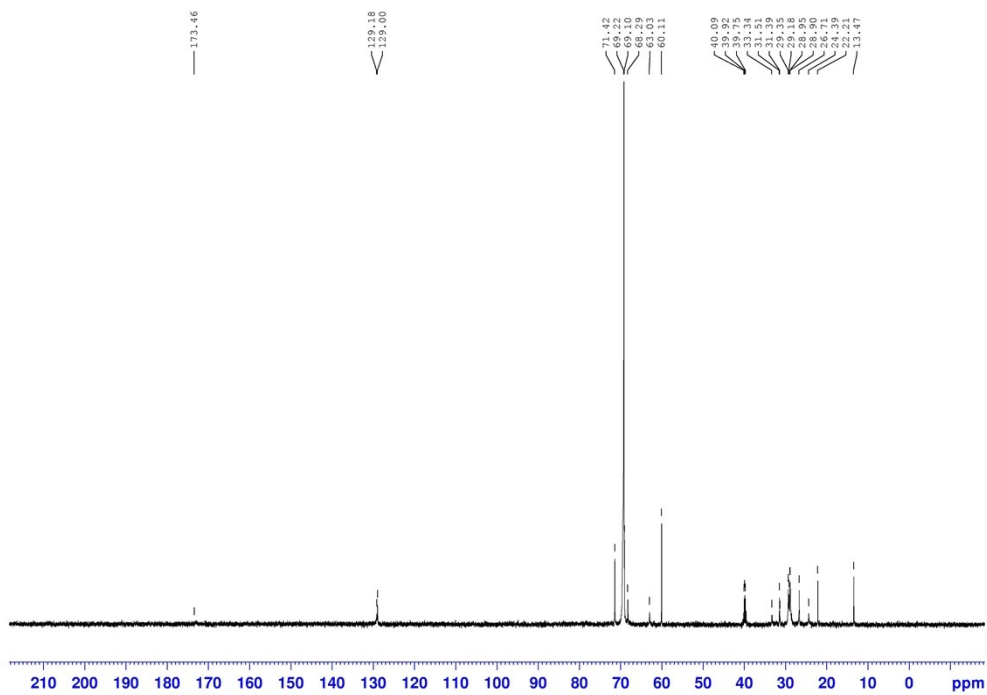
Thermogravimetric analysis (TGA) was carried out with a NETZSCH STA 449 C thermal analyser using alumina crucibles. The sample mass was ca. 10-15mg per measurement. The measurements were carried out under flowing N<sub>2</sub> at a heating rate of 10°C min<sup>-1</sup>.

<sup>13</sup>C NMR spectra of neat Tween-80 and Tween-80 in Tween-80/H<sub>2</sub>O(*R*=1.5) solution were collected at room temperature on a Bruker Avance-400 NMR spectrometer operating at 400.13 MHz. DMSO-*d*<sub>6</sub> was used as an external standard. Chemical shifts were given in ppm downfield from TMS. <sup>13</sup>C NMR spectra of Tween-

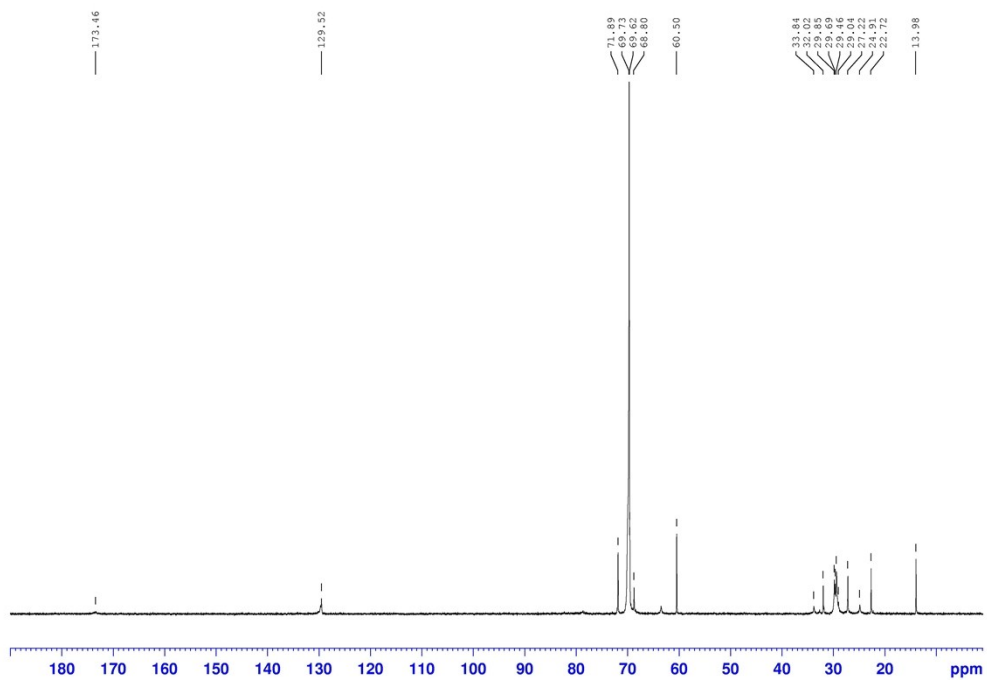
80 in Tween-80/D<sub>2</sub>O(*R*=1.5) solvent and Tween-80/D<sub>2</sub>O(*R*=1.5)/lignin(8 %) solution were collected at room temperature on a Bruker Avance-400 NMR spectrometer operating at 400.13 MHz. D<sub>2</sub>O was used as deuterated solvent and co-solvent in place of H<sub>2</sub>O for the convenience of <sup>13</sup>C NMR measurements due to the similarity of D<sub>2</sub>O with H<sub>2</sub>O. Chemical shifts were given in ppm downfield from TMS. <sup>13</sup>C NMR spectra of Tween-80 were reported as follows.



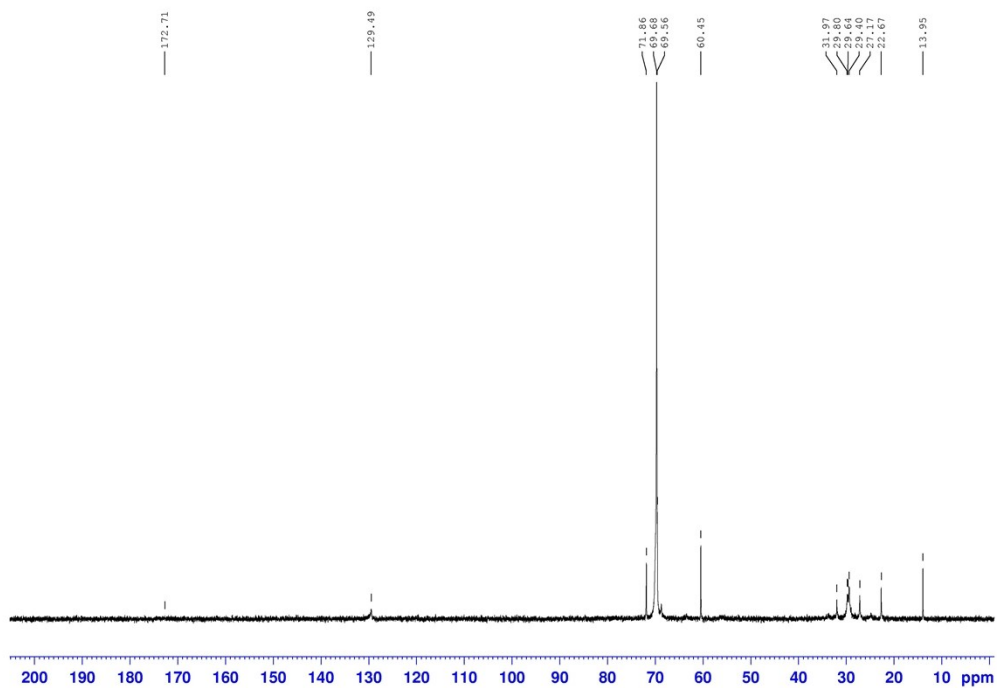
**Fig. S1** <sup>13</sup>C NMR spectra of neat Tween-80. DMSO-*d*<sub>6</sub> was used as an external standard.



**Fig. S2**  $^{13}\text{C}$  NMR spectra of Tween-80 in Tween-80/ $\text{H}_2\text{O}$  ( $R=1.5$ ) solution.  $\text{DMSO-}d_6$  was used as an external standard.



**Fig. S3**  $^{13}\text{C}$  NMR spectra of Tween-80 in Tween-80/ $\text{D}_2\text{O}$  ( $R=1.5$ ) solution.



**Fig. S4**  $^{13}\text{C}$  NMR spectra of Tween-80 in Tween-80/ $\text{D}_2\text{O}$ ( $R=1.5$ )/lignin(8 %) solution.