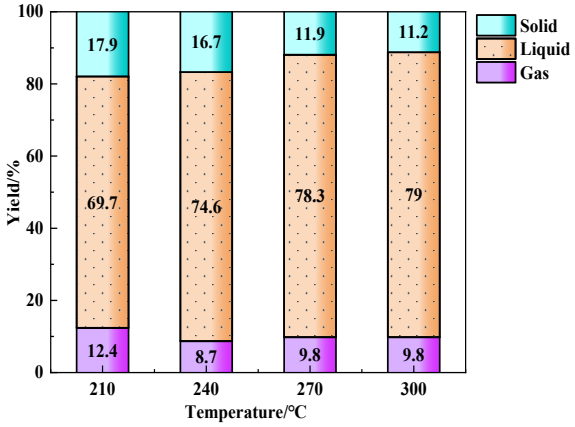

Fig.S1 Three-phase product yield distribution of depolymerization of CLS by Fe_2O_3-$La_{0.8}Sr_{0.2}FeO_3$ at different temperatures

For the catalytic experiment, the other depolymerization temperatures of calcium lignosulfonate was analyzed in the conditional experiment of our previous studies, such as 210℃, 240℃, 270℃, and 300℃. It could be obviously seen in **Fig. S1**, when the depolymerization temperature was 300℃, the yield of liquid phase products was almost as large as that of 270℃, but considering the cost and energy consumption, the optimal depolymerization temperature of CLS was 270℃.

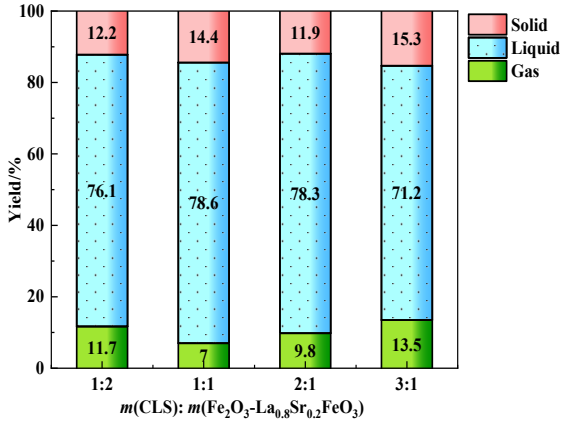

Fig. S2 Three-phase product yields for CLS depolymerization with various mass ratios of Fe_2O_3-$La_{0.8}Sr_{0.2}FeO_3$ catalyst to CLS

During the catalytic depolymerization, the mass ratio of Fe_2O_3-$La_{0.8}Sr_{0.2}FeO_3$

catalyst to CLS was optimized with the value of 1:2, 1:1, 2:1, and 3:1. According to the results in **Fig. S2**, it could be seen that the liquid-phase product yield was 78.6% when *m*(CLS):*m*(Fe_2O_3-$La_{0.8}Sr_{0.2}FeO_3$) 1:1, and 78.3% at 2:1. With the increasing of catalyst mass, the liquid-phase product yield at 3:1 decreased to 71.2%. From the perspective of catalytic efficiency and the production of more liquid products, the 2:1 value was selected to be the appropriate proportion in the following experiments.

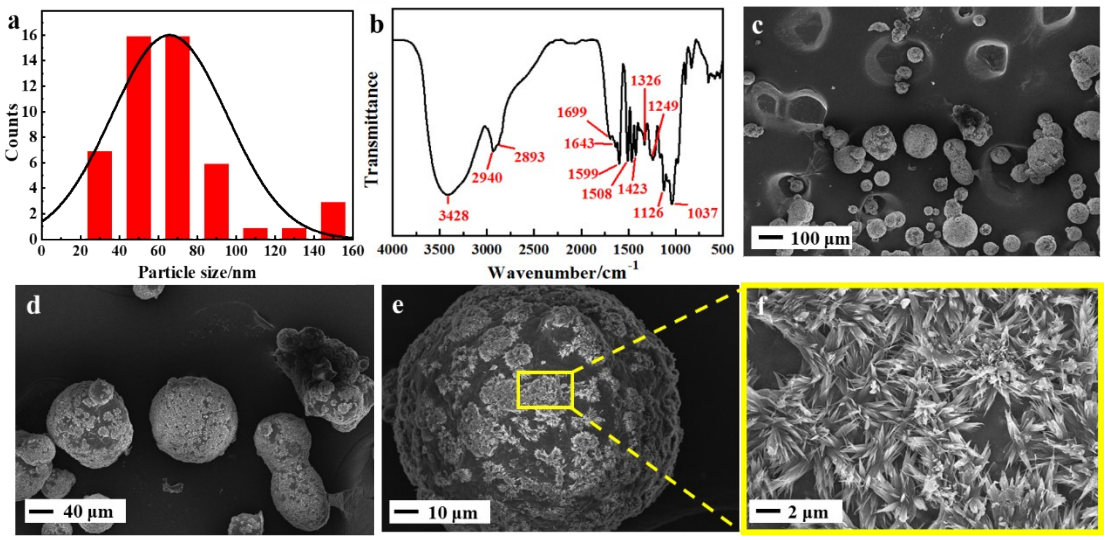

Fig. S3 Particle size distribution (a), FT-IR spectra (b), and SEM images (c-f) of CLS

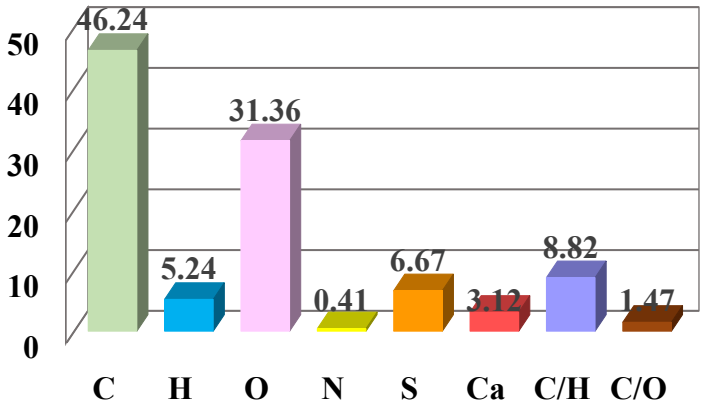

Fig. S4 Elemental analysis of calcium lignosulfonate

Table S1 The orthogonal results of Fe_2O_3 crystals

NO.	Ferric Salt	Precipitant	pH	Temperature	RC[a]/%
1	$Fe(NO_3)_3$	NaOH	9	160	51.15%
2	$FeCl_3$	$NH_3 \cdot H_2O$	5	160	49.83%
3	$Fe_2(SO_4)_3$	Na_2CO_3	7	160	55.96%
4	$Fe(NO_3)_3$	Na_2CO_3	5	180	44.23%
5	$Fe_2(SO_4)_3$	$NH_3 \cdot H_2O$	9	180	38.11%
6	$FeCl_3$	NaOH	7	180	44.86%
7	$FeCl_3$	Na_2CO_3	9	200	96.14%
8	$Fe(NO_3)_3$	$NH_3 \cdot H_2O$	7	200	34.28%
9	$Fe_2(SO_4)_3$	NaOH	5	200	59.55%
k1	43.22%	51.85%	51.20%	52.31%	
k2	63.61%	40.74%	45.03%	42.40%	
k3	51.21%	70.55%	61.80%	63.32%	
R	20.39%	29.81%	16.77%	20.92%	

[a] Relative crystallinity (RC) was calculated from Jade software.

Table S2 The selectivity of liquid-phase products via the depolymerization of CLS

Type	**Selectivity of liquid-phase product/*wt.*%**					
Solvent system	S2	S2	S1	S2	S3	S2
Catalyst	None	Fe_2O_3	LSF-1.0	LSF-1.0	LSF-1.0	$La_{0.8}Sr_{0.2}FeO_3$
Ester	15.64	17.23	25.52	14.98	14.94	22.66
Aromatic	0.70	5.01	5.72	6.35	4.75	3.84
Guaiacol	8.79	8.63	10.94	20.76	17.75	15.82
Syringin	15.60	20.34	13.24	27.19	24.37	13.86
Phenol	13.98	9.04	13.72	11.46	10.33	7.08
Ether	1.22	0.40	0.60	1.38	1.32	0.80
Others	44.07	39.35	30.26	17.88	26.54	35.94
Total selectivity of aryl oxygen-containing compounds	40.29	43.42	44.22	67.14	58.52	41.40

Table S3 The functional groups of the liquid-phase product

Number	Wave length/cm^{-1}	Functional group
1	2991	C-H stretching vibration band
2	1737	Non-conjugated carbonyl C=O stretching vibration band
3	1641	Conjugated carbonyl C=O stretching vibration band
4	1375	Phenolic hydroxyl -OH stretching vibration band
5	1246	Guaiac-based and C=O stretching vibration band
6	1107	Syringyl
7	1049	C-H plane deformation vibrations on the aromatic rings