Supporting Information

One pot synthesis of microporous nanoscale metal organic frameworks conjugated laccase as a promising biocatalyst

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1. Study of morphology of NMOFs:

The effect of laccase immobilization on morphology of NMOFs is scrutinized by preparing NH_2-MIL-53(Al)/laccase was prepared using different amount of laccase (20 mg, 30 mg, 40 mg, and 50 mg) and FESEM image of the particle shown in Fig. S1. It is revealed that laccase concentration has no effect on the morphology of the NMOFs and the particle size is also remain almost same as NH_2-MIL-53(Al).

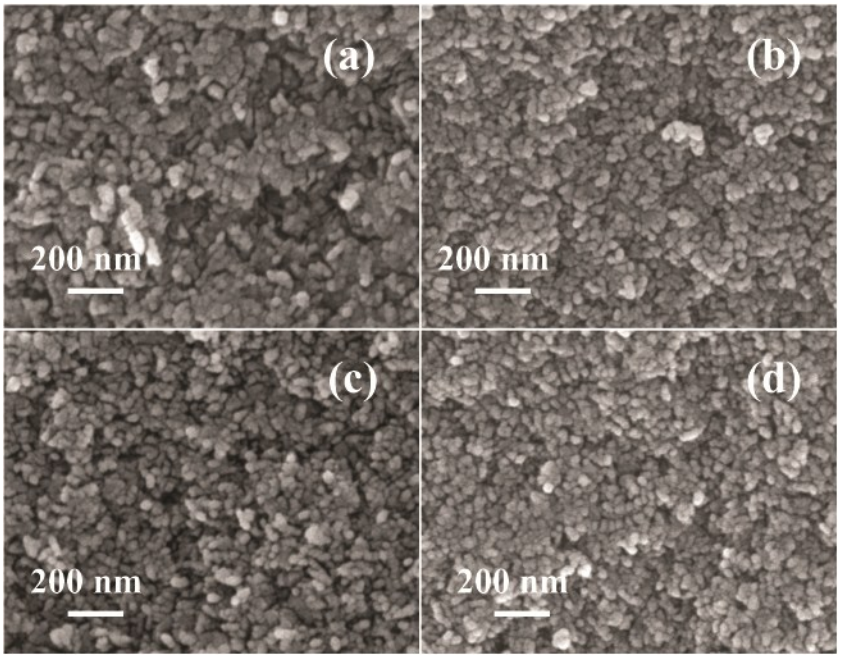

Figure S1. FESEM image of NH_2-MIL-53(Al)/laccase at laccase amount (a) 20 mg (b) 30 mg (c) 40 mg (d) 50 mg.

2. FTIR Study

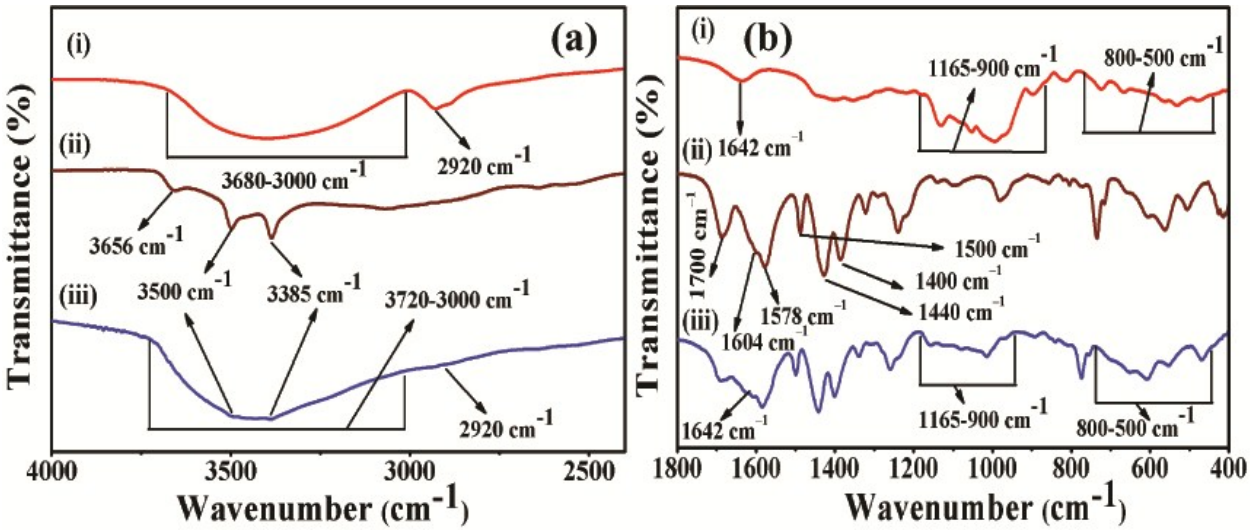

Figure S2. FTIR spectra of (i) laccase, (ii) NH_2-MIL-53(Al) and (iii) NH_2-MIL-53(Al)/laccase

Table S1 Characteristics infrared bands of NH_2-MIL-53(Al)

Approximate frequency (cm^{-1})	**Functional group**	**Reference**
3656	Bridging OH group	43
3500, 3385	NH_2 group	43, 44
1604, 1578	Carboxylate group coordinate to Al	43
1700, 1500	Assymetric stretching of C=O group	44
1440, 1400	symmetric stretching of C=O group	44

Table S2 Characteristics infrared bands of laccase

Approximate frequency (cm^{-1})	Functional group	Reference
3680–3000	OH and NH stretching	45, 46
2920	CH stretching	45, 46
1642–500	Peptide linkage	46–48

Table S3 Characteristics infrared bands of peptide linkage (J. Kong, S. Yu, Acta Biochimica et Biophysica Sinica 39(8) (2007) 549-559)

Designation	Approximate frequency (cm^{-1})	Description
Amide A	3300	NH stretching
Amide B	3100	NH stretching
Amide I	1600–1690	C=O stretching
Amide II	1480–1575	CN stretching, NH bending
Amide III	1229–1301	CN stretching, NH bending
Amide IV	625–767	OCN bending
Amide V	640–800	Out-of-plane NH bending
Amide VI	537–606	Out-of-plane C=O bending

3. Loading capability study

Loading capability of NMOFs is optimized using described procedure. Different amount of laccase (10 mg, 20 mg, 30 mg, 40 mg, and 50 mg) and a constant amount of NMOFs precursor

was used for each batch of synthesis. Then a fixed amount of laccase immobilized NMOFs was collected from the reaction pot and washed well. Then the activity was studied using ABTS activity assay. The activities are compared with free laccase, shown in Fig. S3. It is observed from activity efficiency that 625 mg laccase was loaded in 1 g NMOFs.

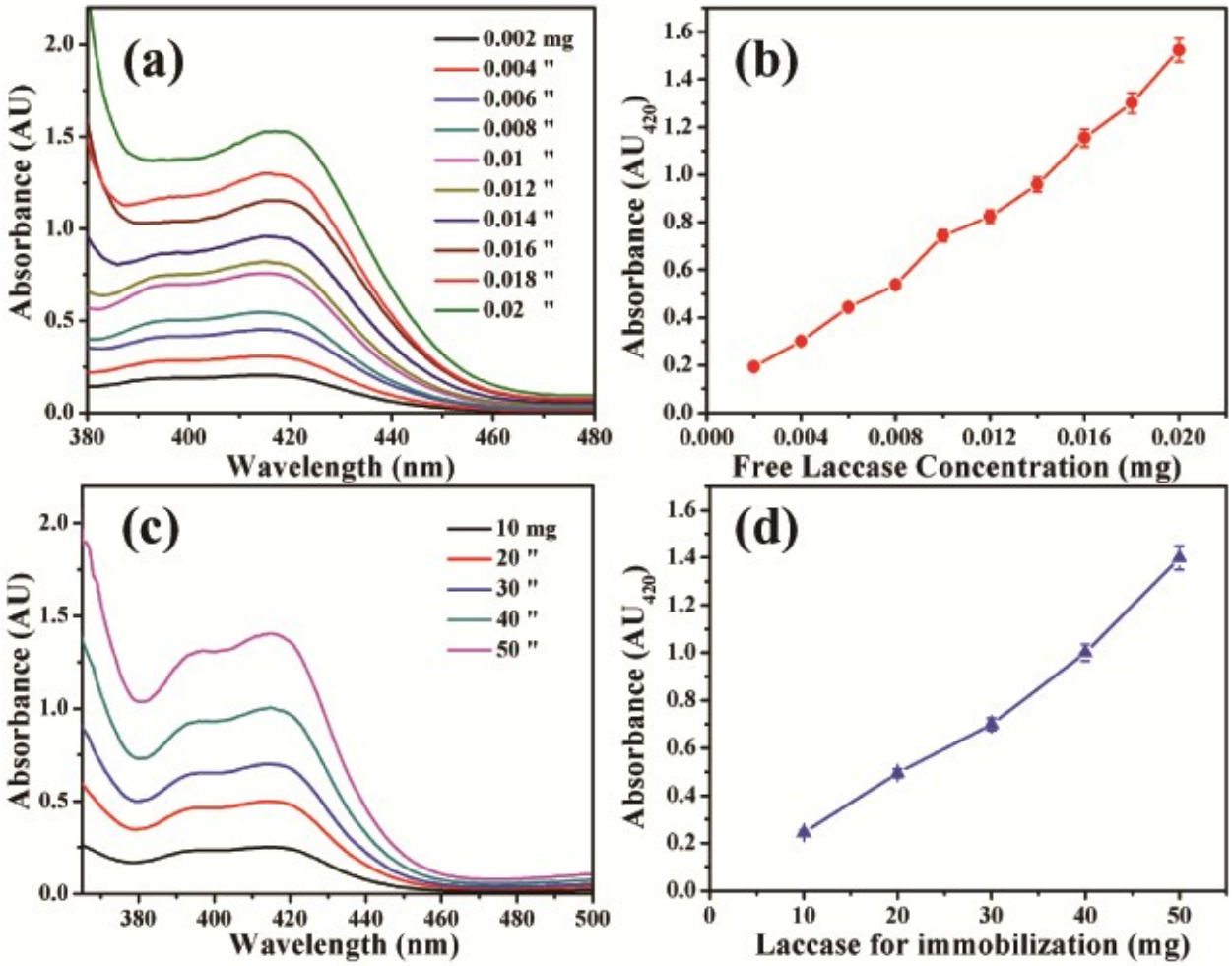

Figure S3. (a) UV spectra at different concentration free laccase, (b) the plot of AU_{420} versus free laccase concentration, (c) UV spectra with respect to different concentration laccase taken at time of onepot synthesis, (d) the plot of AU_{420} versus laccase concentration taken for immobilization.

4. Kinetic study

Table S4 Kinetic parameters of free and immobilized laccase

Support	Kinetic Parameters				Reference
	K_m		V_{max}		
	Free laccase	**Immobilized laccase**	**Free laccase**	**Immobilized laccase**	
NH_2-MIL-53(Al)	0.545 mM/mL	0.8037 mM/mL	0.4418 mM/(mg min)	0.4765 mM/(mg min)	This work
MNPs	1.3 mM	2 mM	56 mM/min	28 mM/min	S. Rouhani et al.[33]
PAN/O-MMT composite nanofibrous	120.32 μM	622.15 μM	595.24 μmol/(mg min)	293.46 μmol/(mg min)	G. Li et al.[40]
SiO_2 nanoparticles	29.3 μM	46.5 μM	1,890 μmol/(min mg)	1,630 μmol/(min mg)	S. K. S. Patel et al.[51]
Cu(II)-chelated magnetic microspheres	98 μmol/L	205 μmol/L	578 μmol/(mg min)	293 μmol/(mg min)	J. Lin et al.[52]
Mn(II)-chelated magnetic microspheres	98 μmol/L	215 μmol/L	578 μmol/(mg min)	337 μmol/(mg min)	J. Lin et al.[52]