Supplementary Information

Modulation of starch nanoparticles surface characteristics for facile construction of recycling Pickering interfacial enzymatic catalysis

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Figure.S1 XRD diffraction spectrum of samples.

Figure.S2 Size distribution of MS, MS-AP (2) and MS-AP (3) calculated by dynamic light scattering.

Figure.S3 CD spectra of native CALB (red curve) and CALB released from Pickering emulsion droplets (black curve).

Figure.S4 Nitrogen sorption isotherms for microcapsules formed by (A) MS-AP (2) and (B) MS-AP (3).

Figure. S5 Molecular model of the substrates used and products formed in the transesterification.

Figure.S6 Lineweaver-Burk plot of the reciprocal of initial rate (1/v) versus the reciprocal of the substrate concentration (1/[S]) for the determination of kinetic parameters K_m and v_{max} of CALB loaded pure Pickering emulsion.

Figure.S7 Temperature effects on the kinetics of transesterification in the o/w and w/o Pickering interfacial catalytic system. (A) Kinetics plots for the o/w Pickering interfacial catalytic system at different temperatures. (B) Kinetics plots for the w/o Pickering interfacial catalytic system at different temperatures. (C) ln k versus 1/T for transesterification in the o/w and w/o Pickering interfacial catalytic system.

Figure.S8 Microscopy images of the w/o Pickering emulsion in consecutive reaction cycles (1st, 2nd, 5th and 10th cycle). Scale bar: 25μm.

Figure.S9 CD spectra of native CALB in Tris-HCl buffer at 25 °C (red curve) and 45°C (black curve).

Figure.S10 Microscopy images of the o/w Pickering emulsion in consecutive reaction cycles (1st, 2nd, 5th and 10th cycle). Scale bar: 50μm.

Table.S1 Zeta potential of samples at pH 7.2

Table. S2 Relationship of stirring input power and stirring rate.
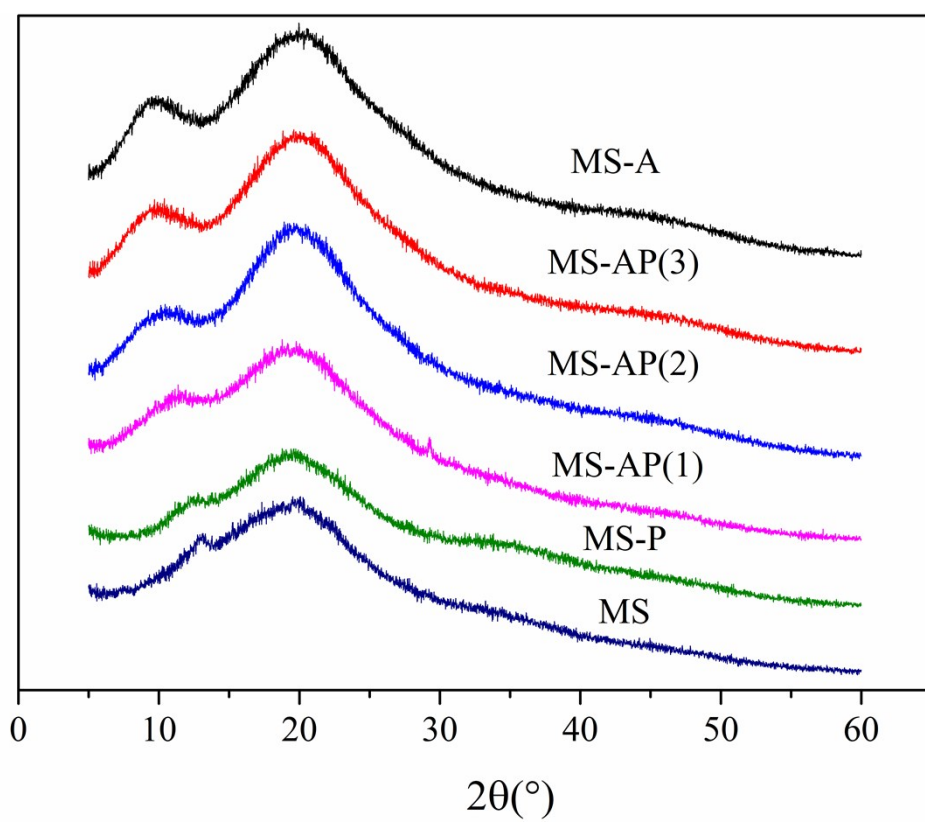
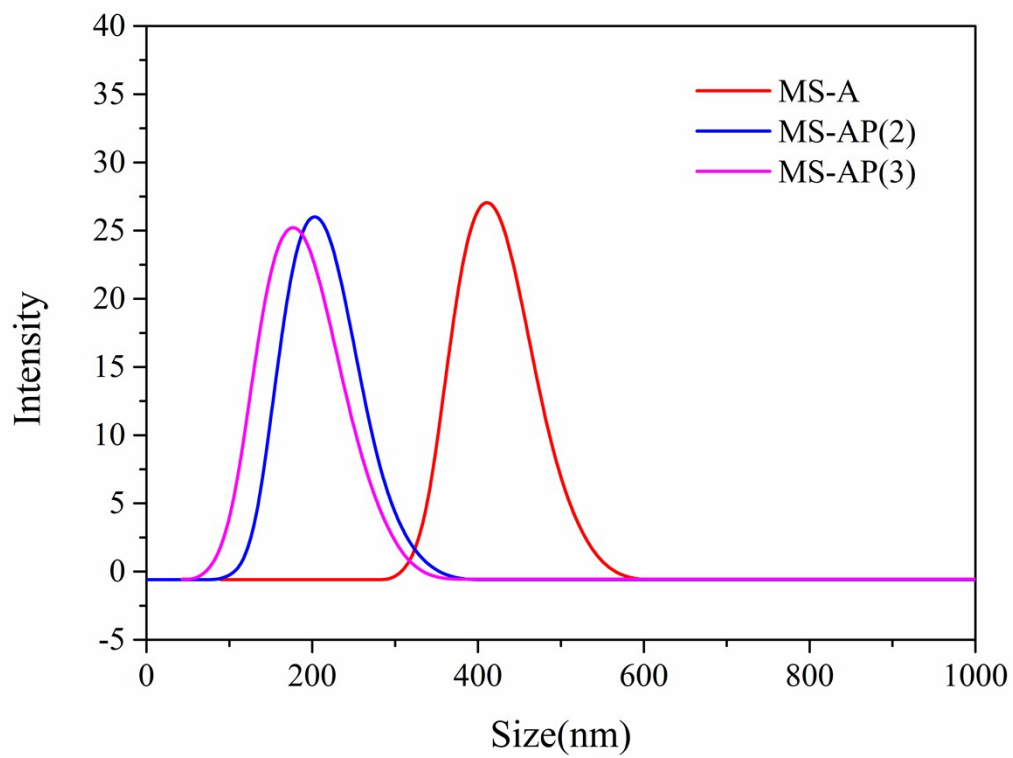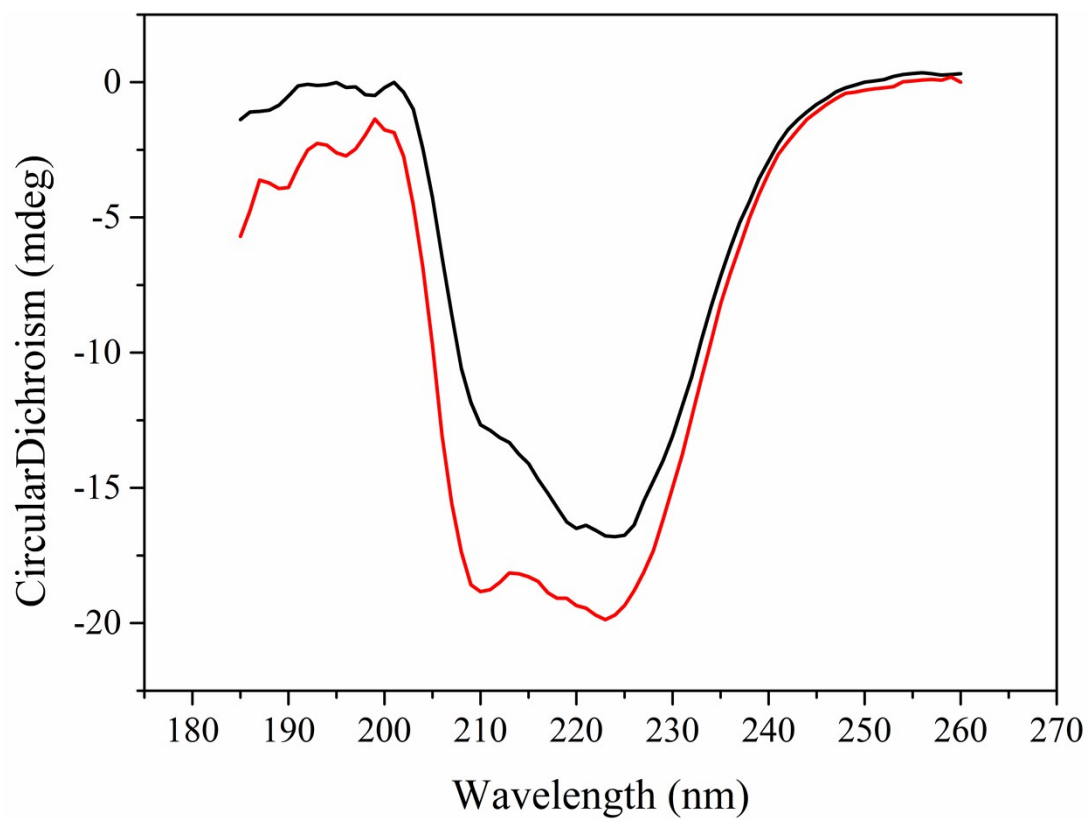**Figure.S1** XRD diffraction spectrum of samples.

Figure.S2 Size distribution of MS, MS-AP (2) and MS-AP (3) calculated by dynamic light scattering.

Table.S1 Zeta potential of samples at pH 7.2

Samples	MS	MS-A	MS-AP (3)	MS-AP (2)	MS-AP (1)	MS-P
Zeta potential (mV)	-7.19±0.83	-5.23±0.45	-14.86±1.16	-18.4±0.89	-22.53±0.83	-26.93±1.07

Figure.S3 CD spectra of native CALB (red curve) and CALB released from Pickering emulsion droplets (black curve).

Table. S2 Relationship of stirring input power and stirring rate [a].

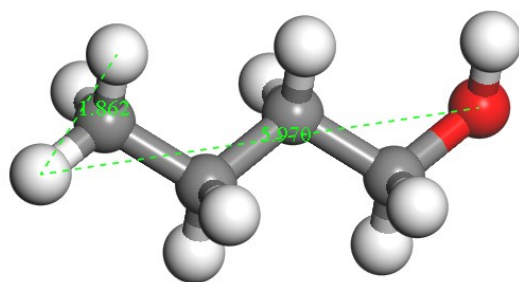| Stirring input power （W）	5	10	12.5	15	17.5	20	22.5	25
Stirring rate(rpm)	200	400	600	800	1000	1200	1400	1600

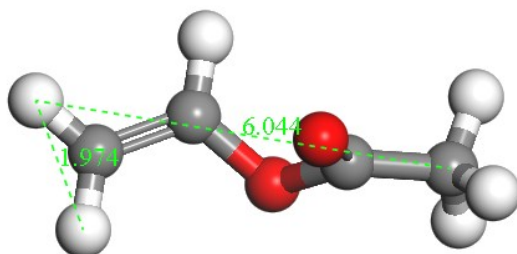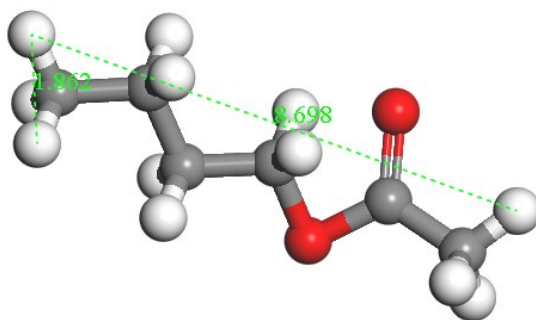[a] The stirring speed is measured using water as medium
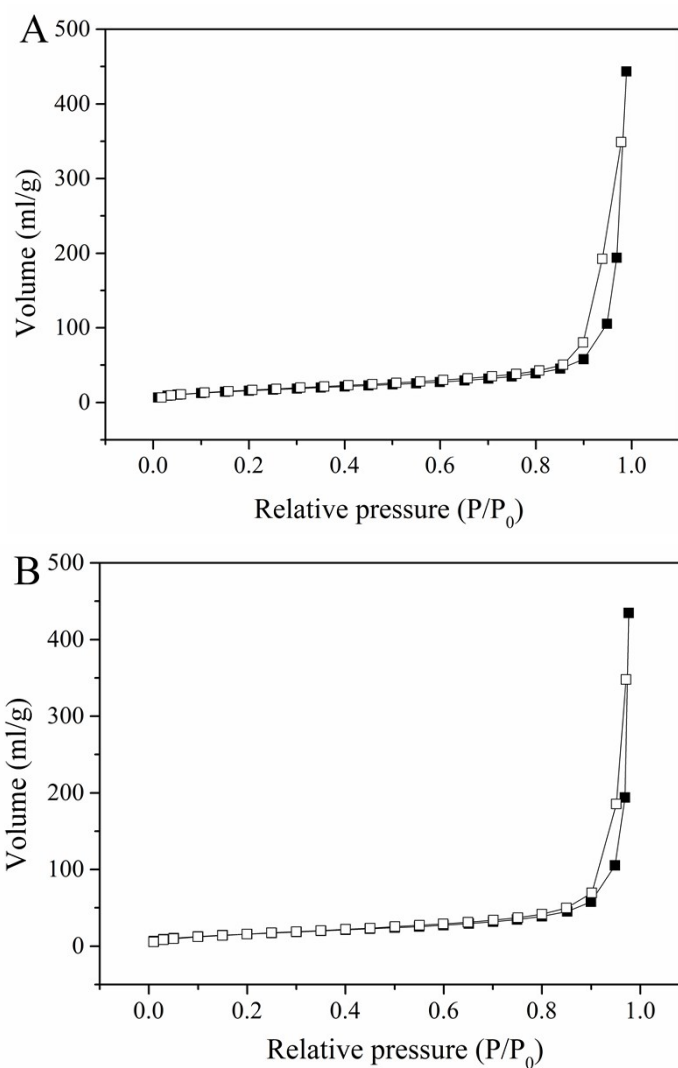
Figure.S4 Nitrogen sorption isotherms for microcapsules formed by (A) MS-AP (2) and (B) MS-AP (3).

1-butanol

vinyl acetate

butyl acetate

Figure. S5 Molecular model of the substrates used and products formed in the transesterification.

Kinetic study of CALB inducing biocatalysis in pure Pickering emulsion:

Typically, substrates 1-butanol and vinyl acetate at different concentrations (50 mM, 100 mM, 150 mM, 200 mM, 250 mM) were added into the CALB loaded o/w and w/o pure Pickering emulsions to start the reaction. The initial reaction rates (mM·min^{-1}) were evaluated by linear regression of the experimental data from a plot of the product butyl acetate concentration versus time. The slope of the curve during the first 10 min was defined as the initial reaction rate. The apparent kinetic parameters Michaelis constant-K_m and the maximum reaction rate-v_{max} were calculated according to the Lineweaver-Burk equation (Eqn. 1):

$$\frac{1}{v}=\frac{K_m}{v_{max}[S]}+\frac{1}{v_{max}}$$

（1）

Where v is the initial velocity, v_{max} is the maximal reaction velocity and [S] is the concentration of substrate. **Fig.S6** showed the plot of the reciprnocal of the reaction rate, v (mM·min^{-1}), versus the reciprocal of the substrate concentration, [S] (mM). Accordingly, the 1/v and 1/[S] were related to the Eqn.2 and 3:

$$\frac{1}{v}=26.49\frac{1}{[S]}+0.057$$

（2）

$$\frac{1}{v}=60.45\frac{1}{[S]}+0.114$$

（3）

we found that the CALB in o/w emulsion showed a K_m value of 464 mM and a v_{max} value of 17.54 mM·min^{-1}, whereas the K_m and v_{max} of CALB in w/o emulsion

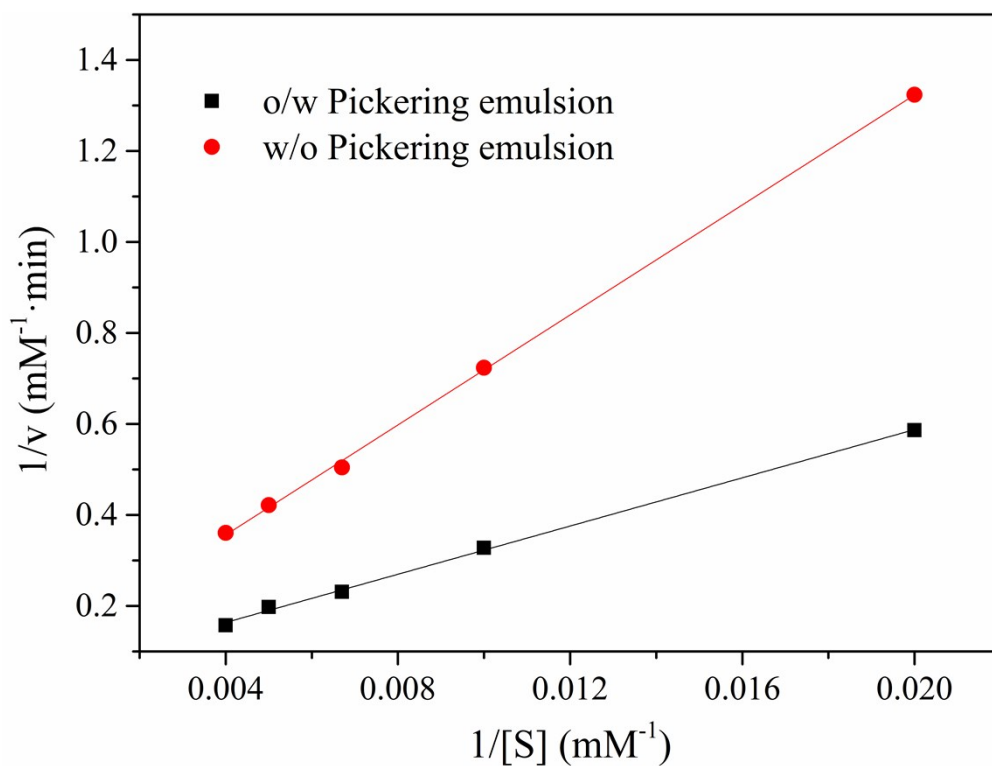was 547 mM and 8.77 mM·min^{-1}, respectively.

Figure.S6 Lineweaver-Burk plot of the reciprocal of initial rate (1/v) versus the reciprocal of the

substrate concentration (1/[S]) for the determination of kinetic parameters K_m and v_{max} of CALB
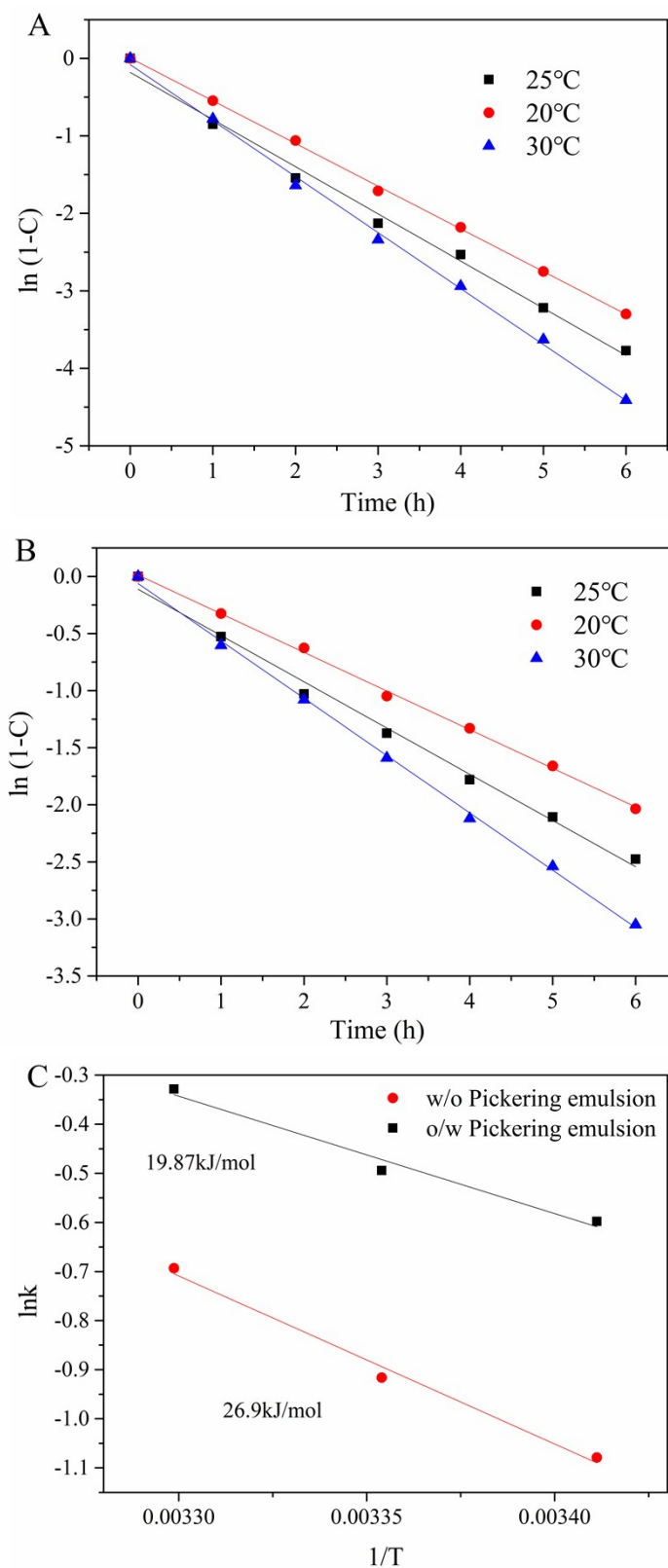
loaded pure Pickering emulsion.

Figure.S7 Temperature effects on the kinetics of transesterification in the o/w and w/o Pickering

interfacial catalytic system. (A) Kinetics plots for the o/w Pickering interfacial catalytic system at

different temperatures. (B) Kinetics plots for the w/o Pickering interfacial catalytic system at

different temperatures. (C) ln k versus 1/T for transesterification in the o/w and w/o Pickering
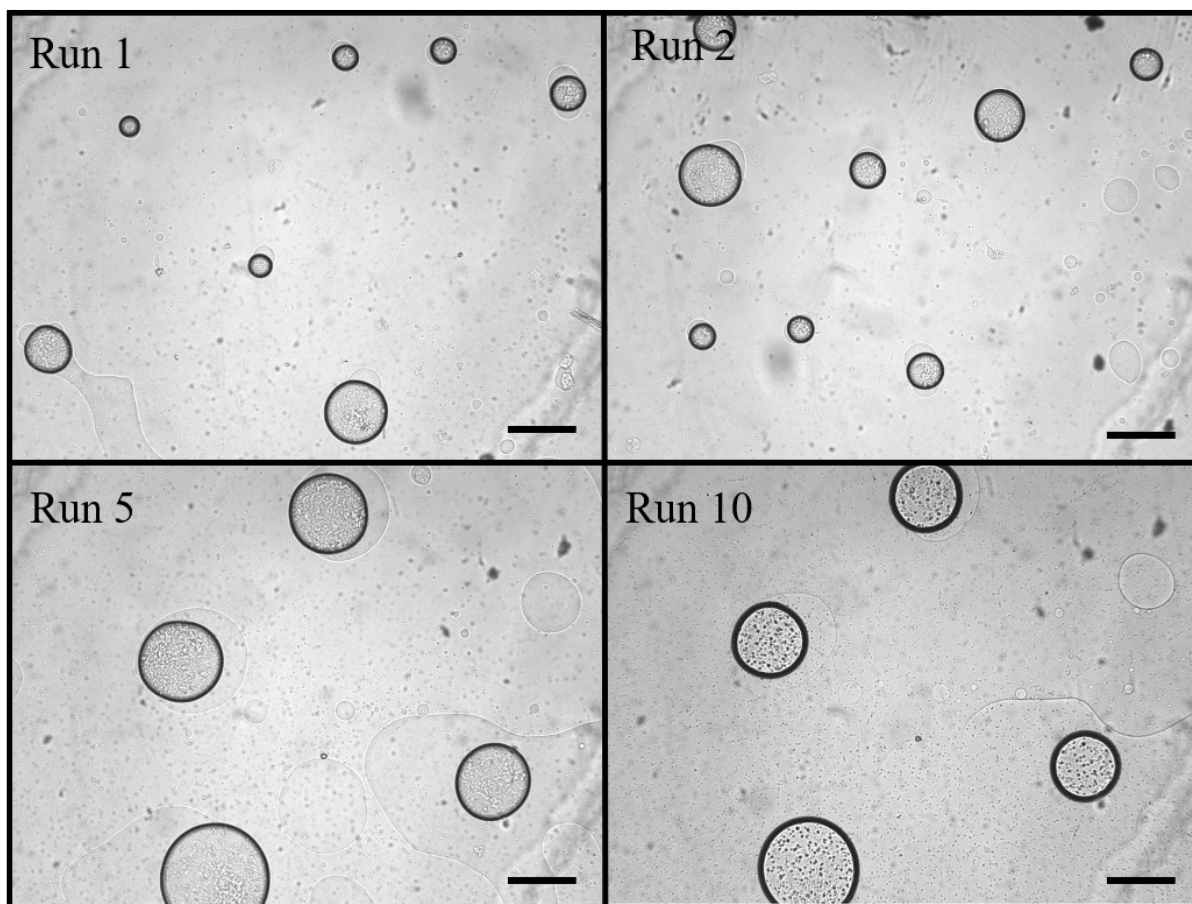
interfacial catalytic system.

Figure.S8 Microscopy images of the w/o Pickering emulsion in consecutive reaction cycles (1st,

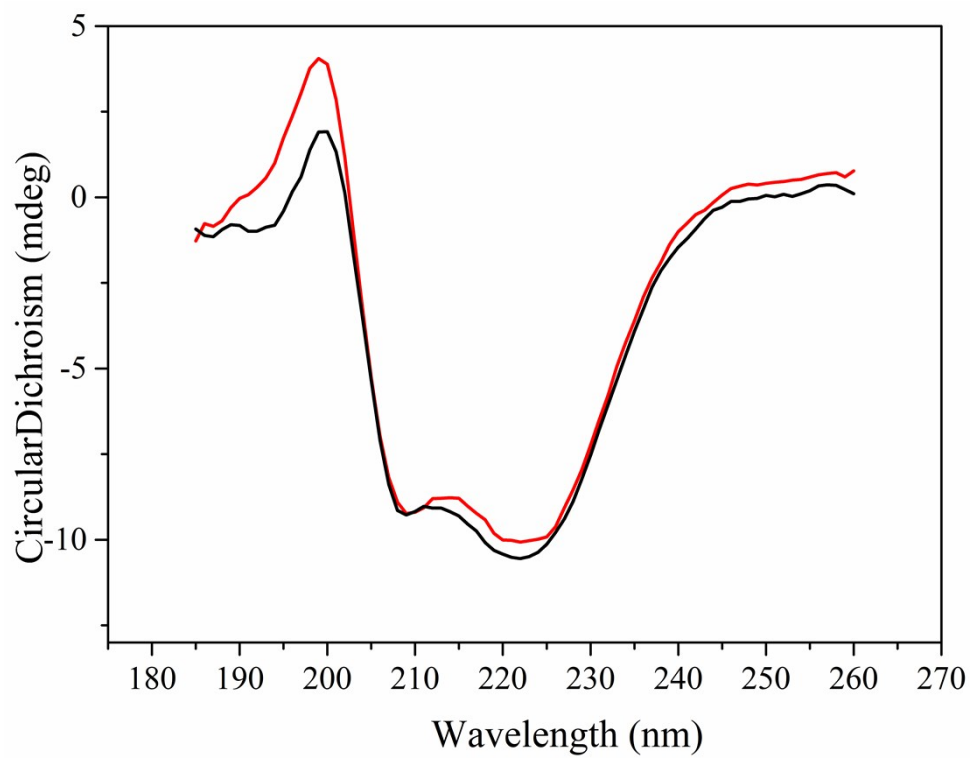2nd, 5th and 10th cycle). Scale bar: 25μm.

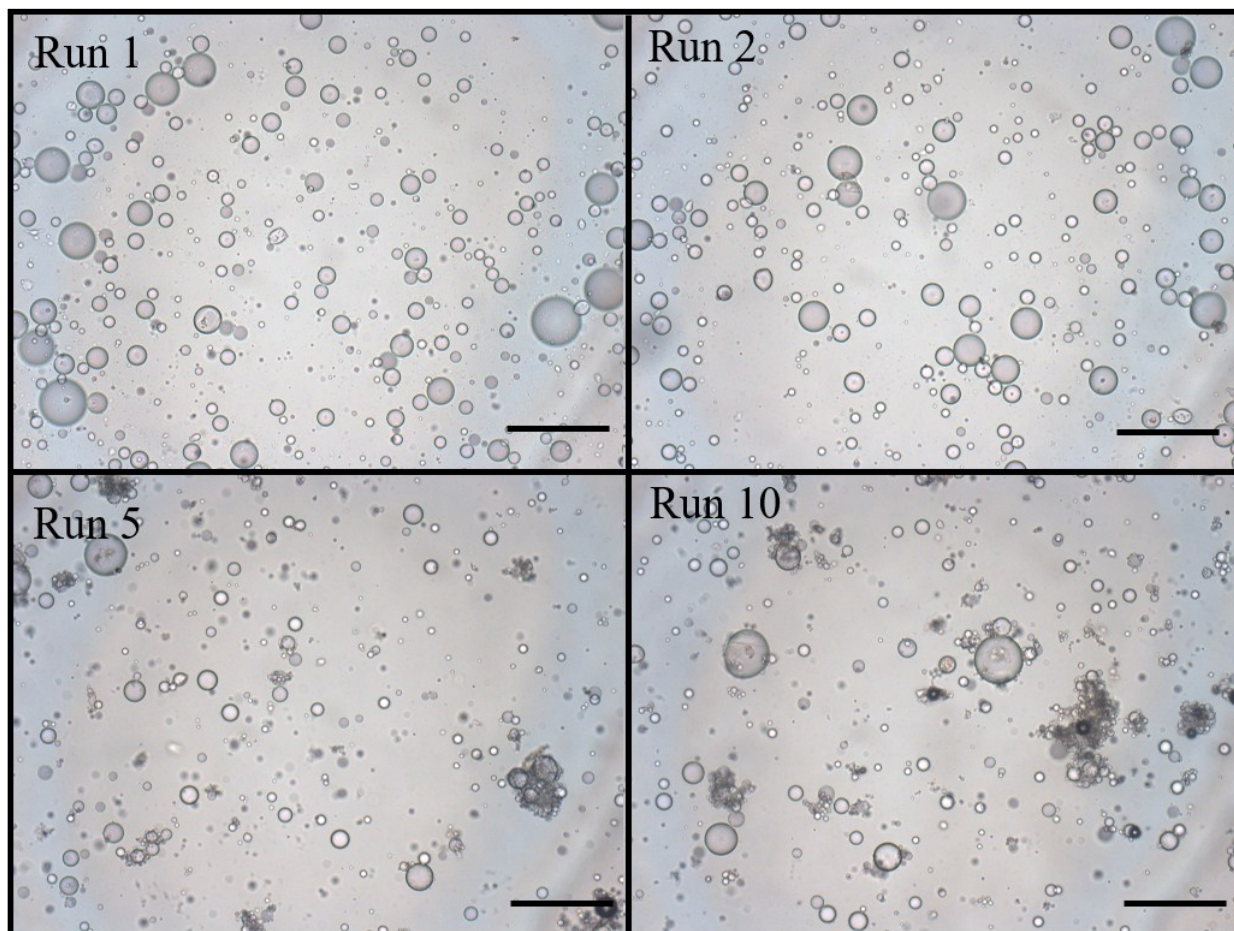**Figure.S9** CD spectra of native CALB in Tris-HCl buffer at 25 °C (red curve) and 45 °C (black curve).

Figure.S10 Microscopy images of the o/w Pickering emulsion in consecutive reaction cycles (1st,

2nd, 5th and 10th cycle). Scale bar: 50μm.