Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supporting Information

Hydroxyl-anchored covalent organic crown-based polymers for CO_2 fixation into cyclic carbonates at mild condition

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1. TEM images of COCP-OH

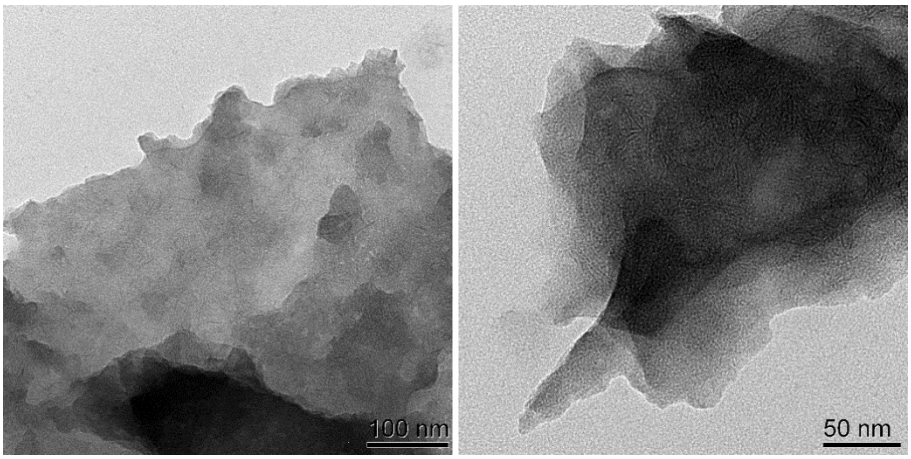

Fig. S1 TEM images of COCP-OH

2. BET images of COCP-NH_2

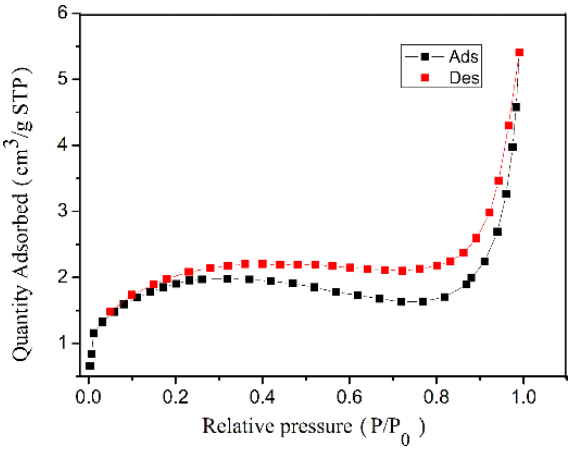

Fig. S2 The N_2 adsorption and desorption isotherms of COCP-NH_2

3. The calculation method of product yield

For all epoxides and corresponding cyclic carbonate, the proton chemical shift could be distinguished, and the peak areas represent the relative content of proton. Therefore the yield could calculate by the ratio of cyclic carbonates to epoxides according to the relative content of proton in cyclic carbonate and epoxide. Take table 1-4 for example, the calculation method is as followed.

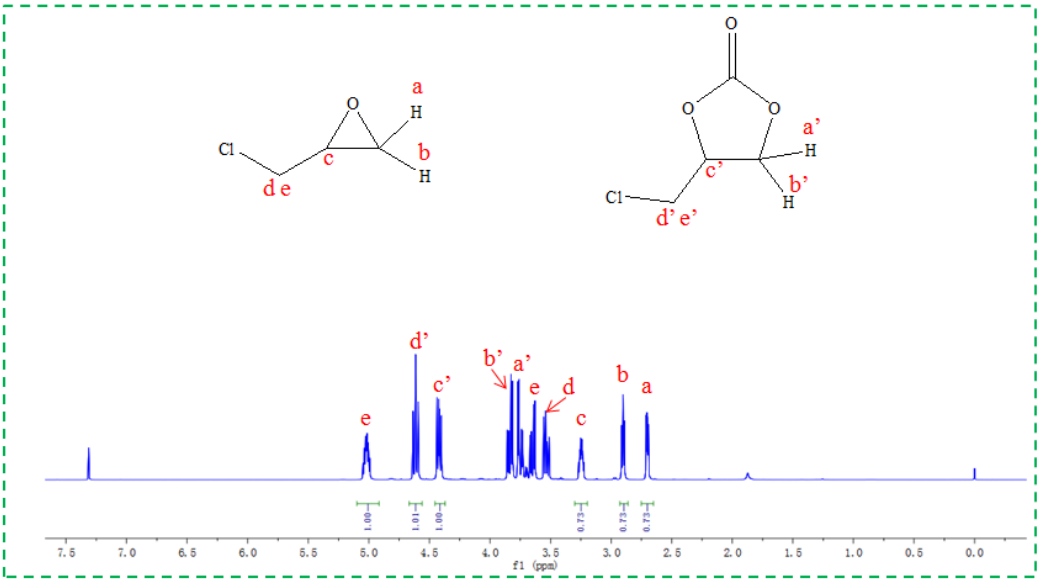

Fig. S3 The chemical shift and area of mixture of ECH and cyclic carbonate

$$\text{Yield (\%)} = \frac{\text{Average area of cyclic carbonate}}{\text{Average area of cyclic carbonate} + \text{Average area of epoxide}}$$

$$\text{Average area of cyclic carbonate} = \frac{A_{c'} + A_{d'} + A_{e'}}{3} = \frac{3.01}{3} = 1.003$$

$$\text{Average area of epoxide} = \frac{A_a + A_b + A_c}{3} = \frac{2.19}{3} = 0.73$$

$$\text{Yield (\%)} = \frac{1.003}{1.003 + 0.73} \times \% = 57.9\%$$

All ^{1}H-NMR results in manuscript are shown as followed:

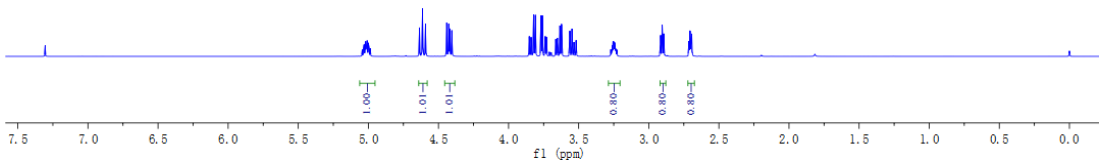

Fig. S4 The chemical shift and area of mixture of ECH and cyclic carbonate (Table 1-1)

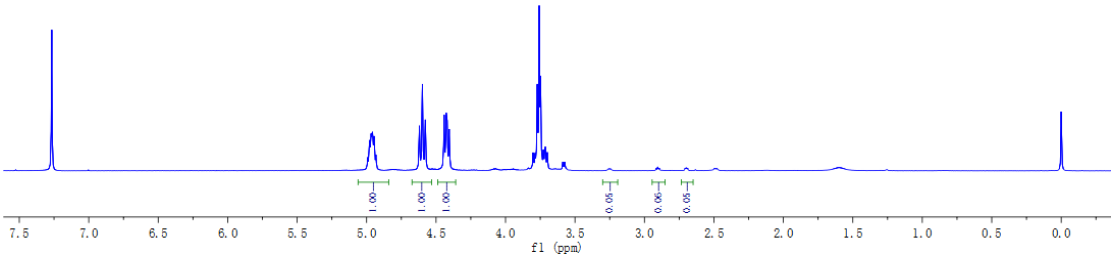

Fig. S5 The chemical shift and area of mixture of ECH and cyclic carbonate (Table 1-2)

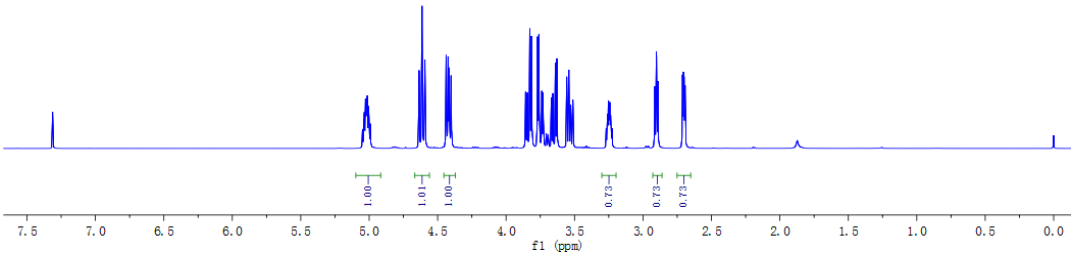

Fig. S6 The chemical shift and area of mixture of ECH and cyclic carbonate (Table 1-3)

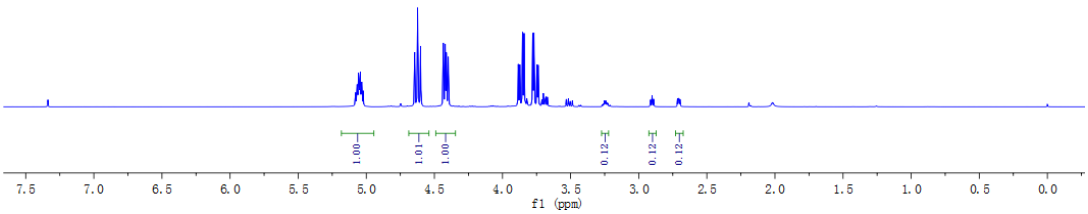

Fig. S7 The chemical shift and area of mixture of ECH and cyclic carbonate (Table 1-4)

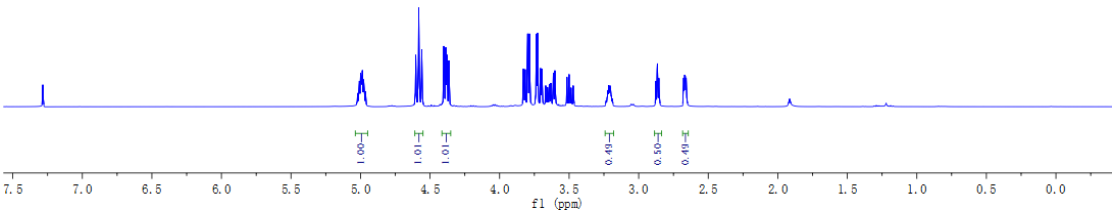

Fig. S8 The chemical shift and area of mixture of ECH and cyclic carbonate (Table 1-5)

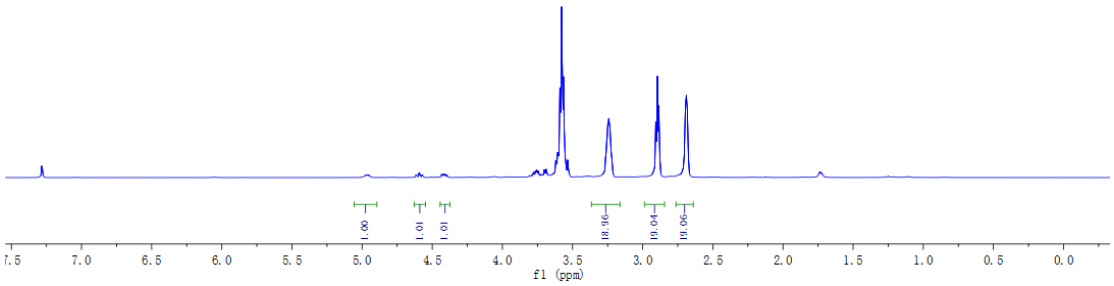

Fig. S9 The chemical shift and area of mixture of ECH and cyclic carbonate (Table 1-6)

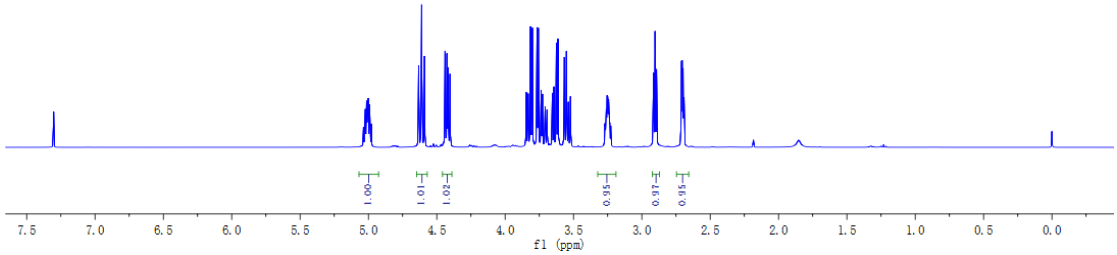

Fig. S10 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.5-1)

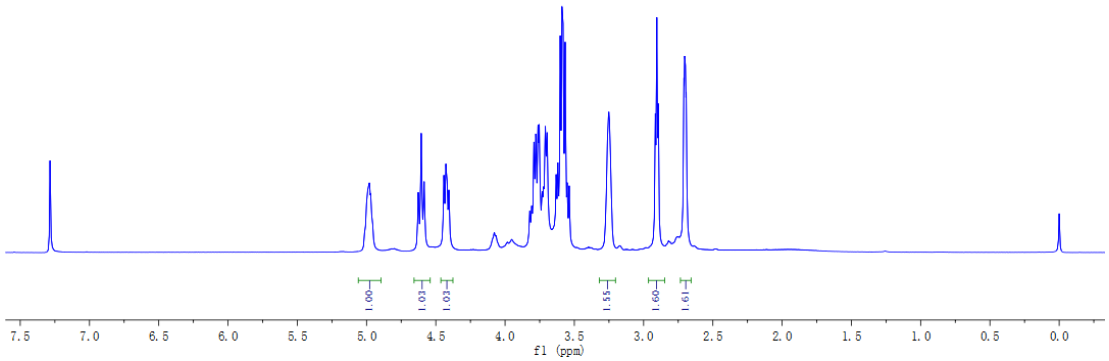

Fig. S11 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.5-2)

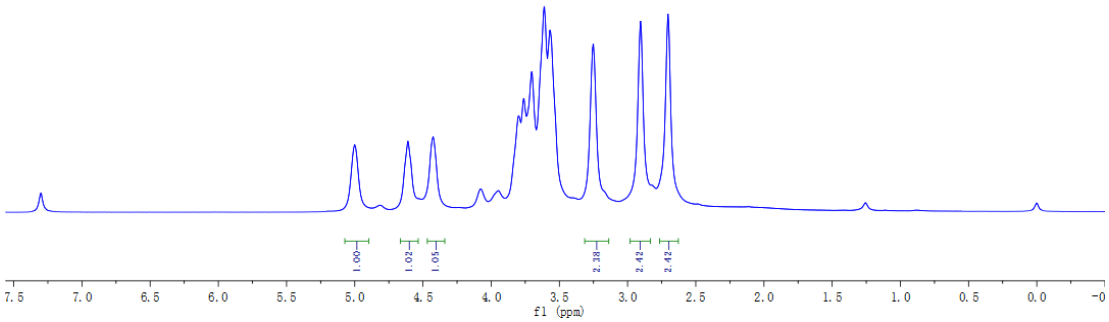

Fig. S12 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.5-3)

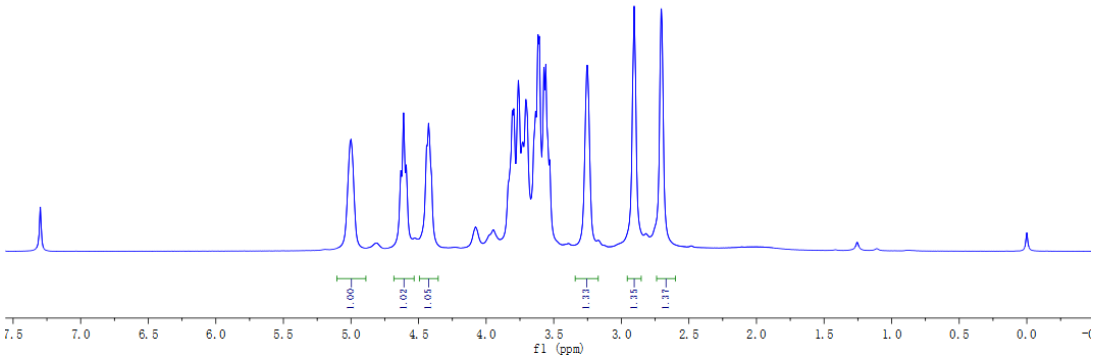

Fig. S13 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.5-4)

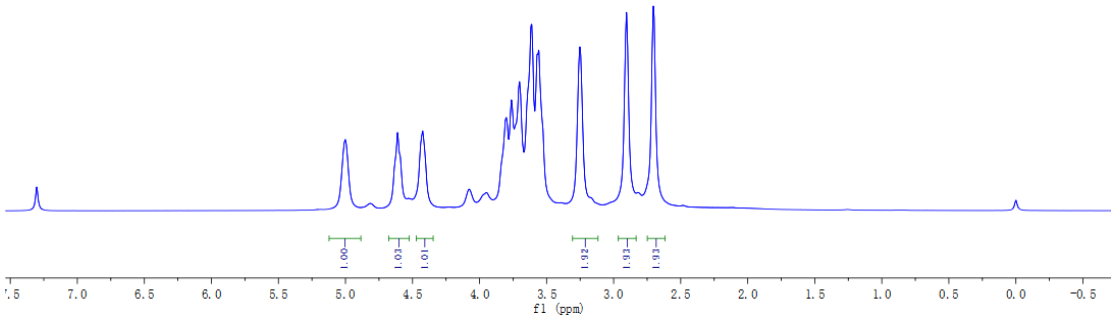

Fig. S14 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.5-5)

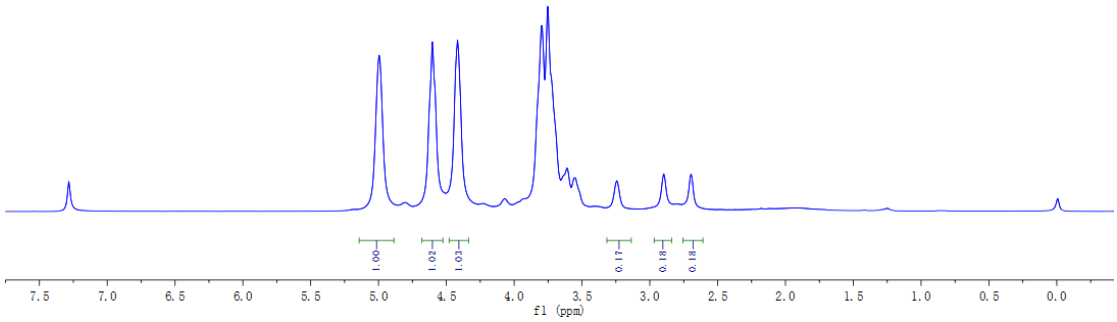

Fig. S15 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 a-1)

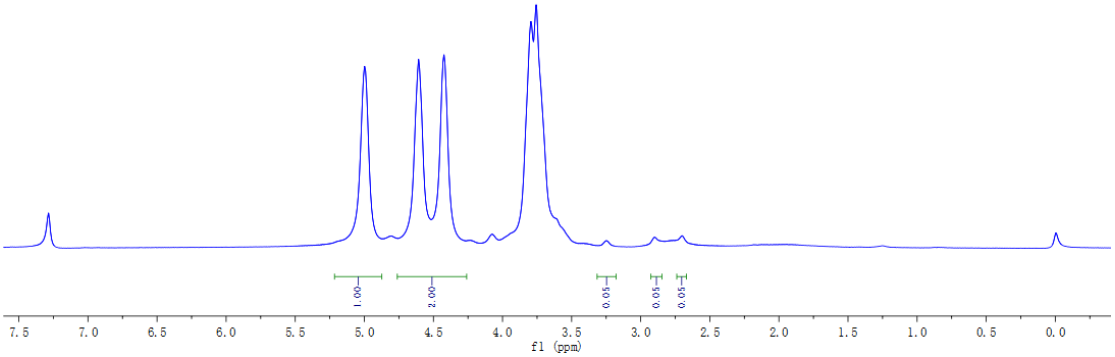

Fig. S16 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 a-3)

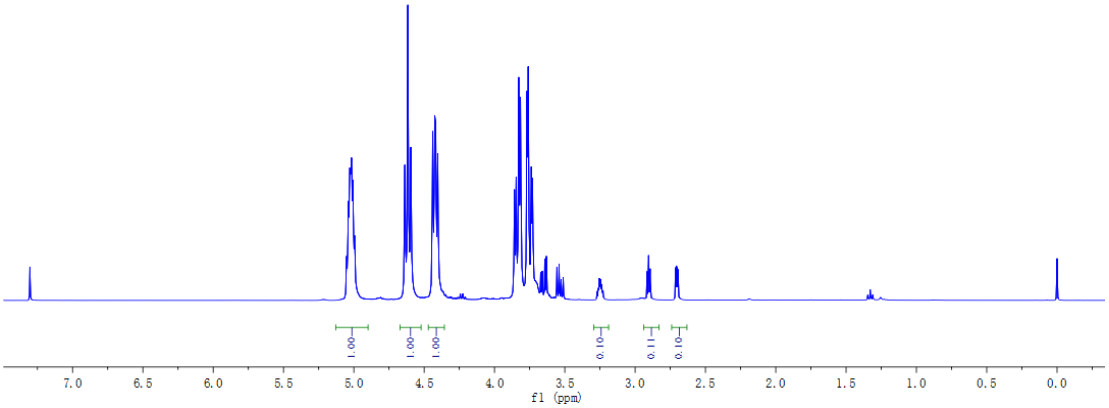

Fig. S17 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 b-1)

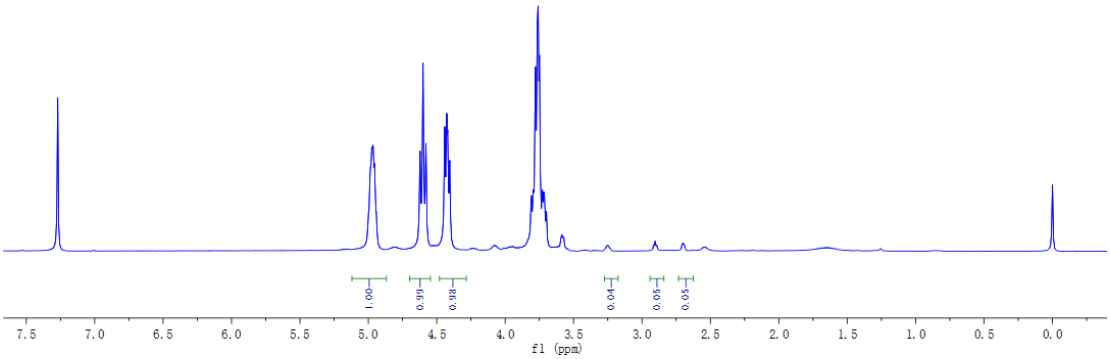

Fig. S18 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 b-3)

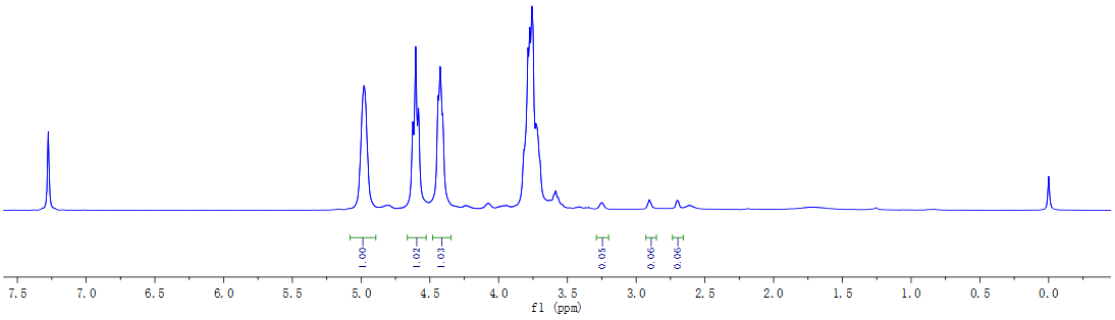

Fig. S19 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 b-4)

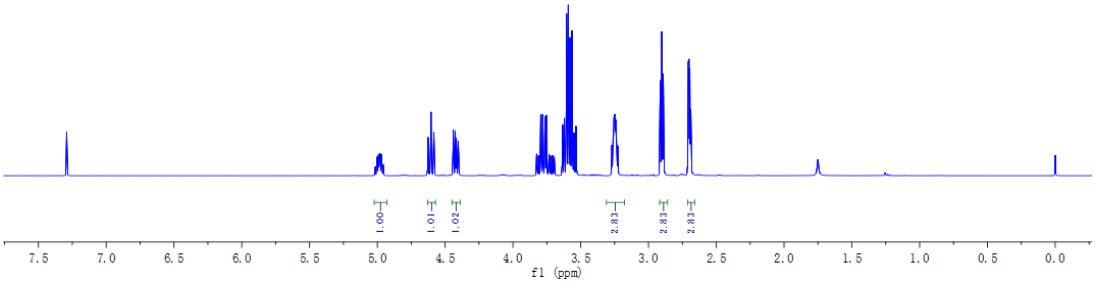

Fig. S20 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 c-30 ℃)

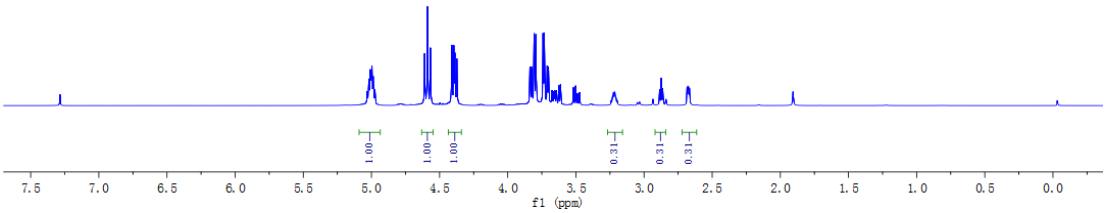

Fig. S21 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 c-40 ℃)

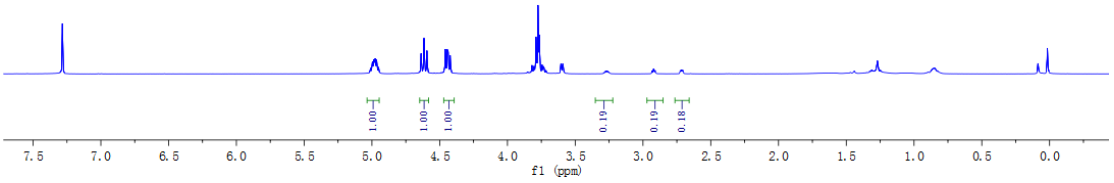

Fig. S22 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 c-50 ℃)

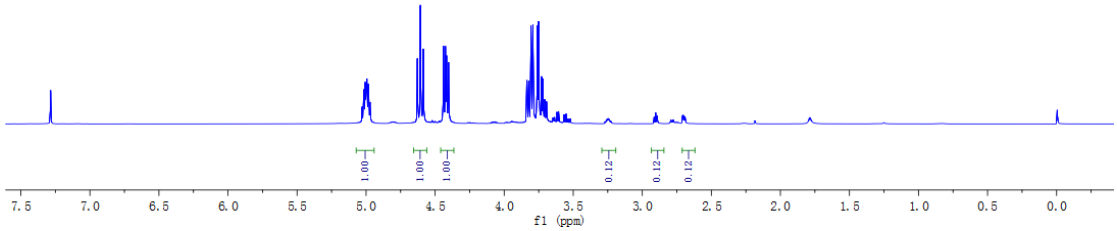

Fig. S23 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 c-60 ℃)

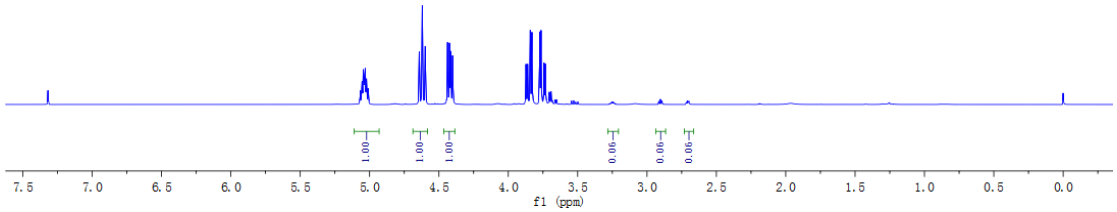

Fig. S24 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 c-80 ℃)

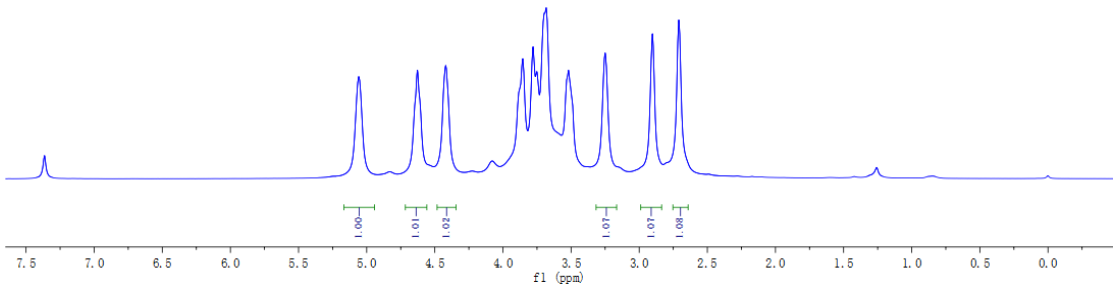

Fig. S25 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 d-4h)

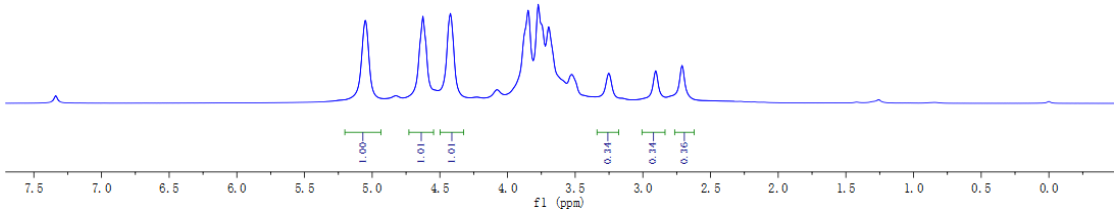

Fig. S26 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 d-8h)

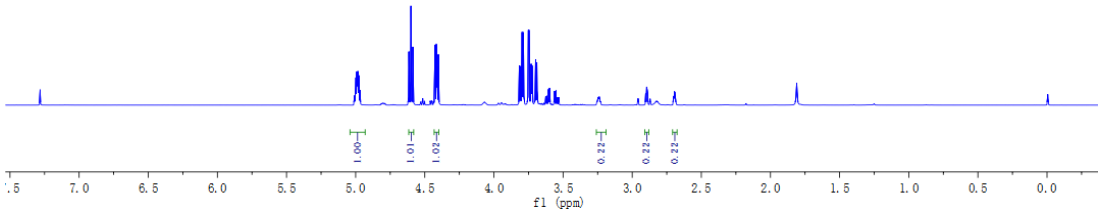

Fig. S27 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 d-12h)

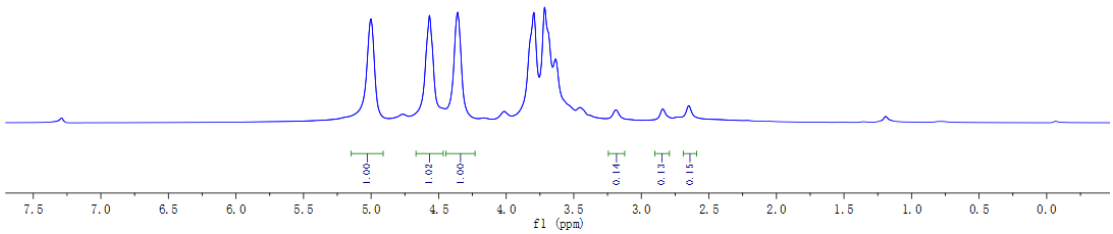

Fig. S28 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 d-16h)

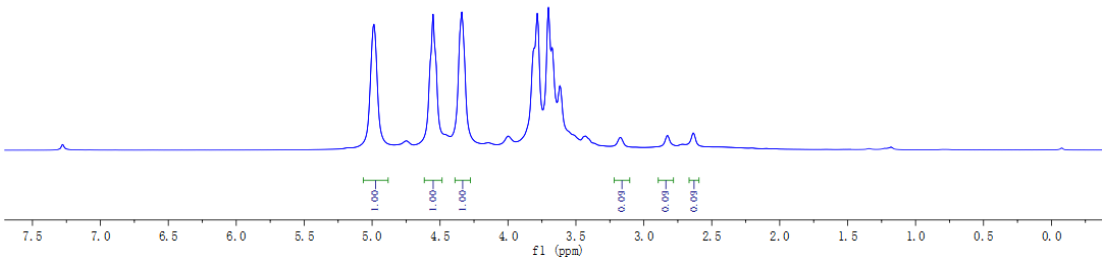

Fig. S29 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 d-20h)

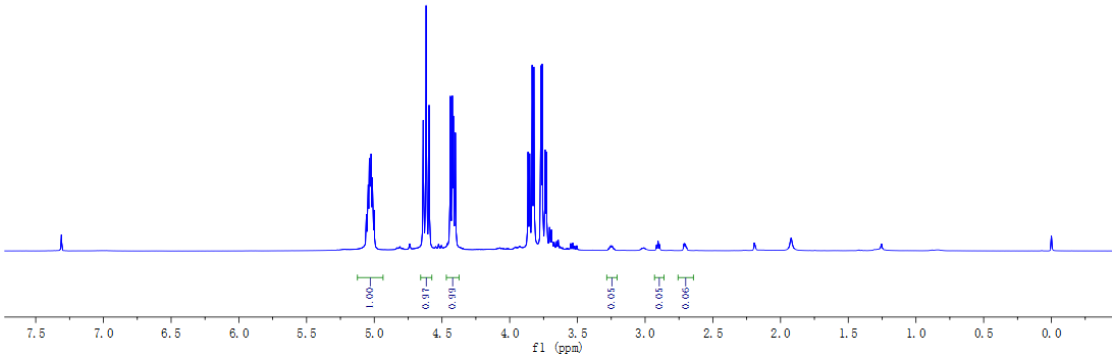

Fig. S30 The chemical shift and area of mixture of ECH and cyclic carbonate (Fig.6 d-28h)

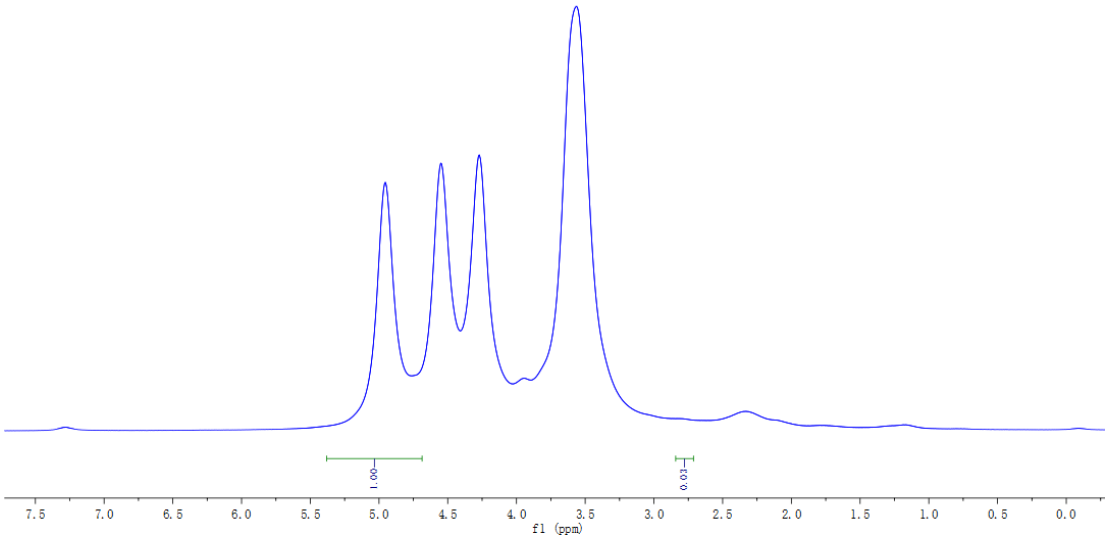

Fig. S31 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-2)

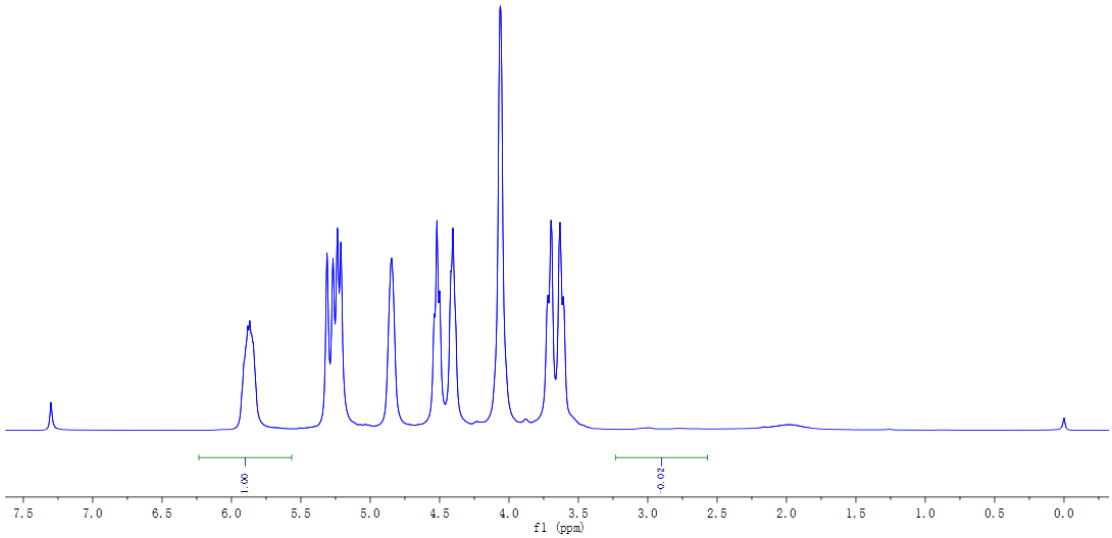

Fig. S32 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-3)

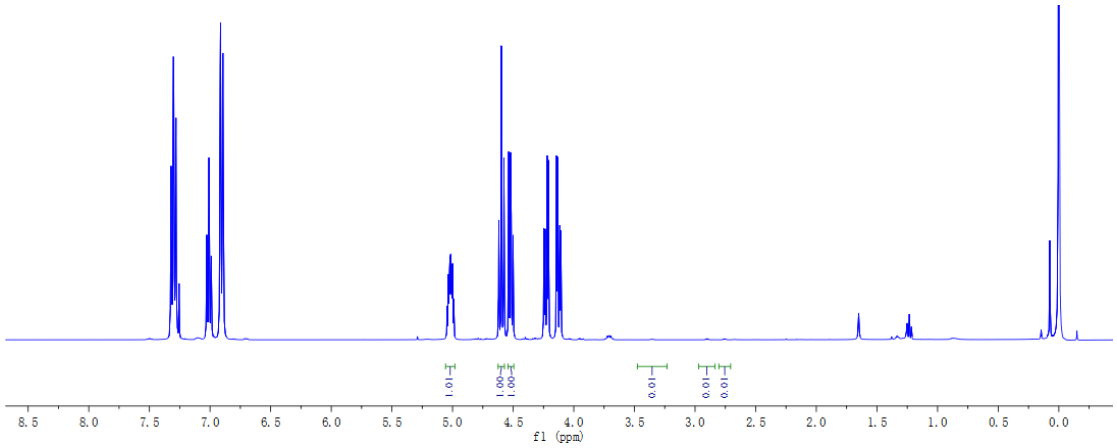

Fig. S33 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-4)

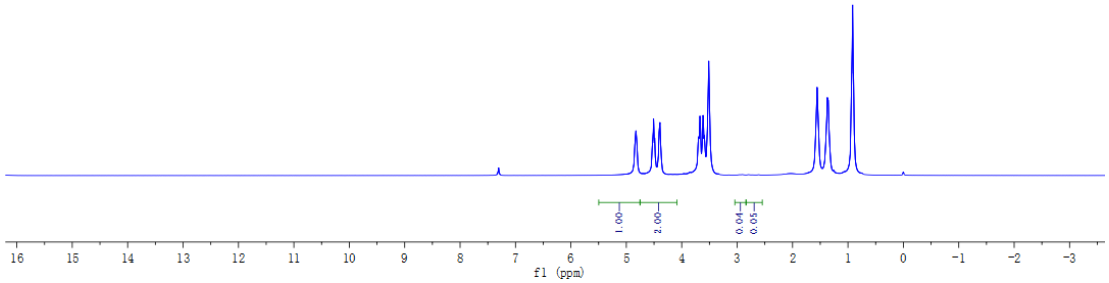

Fig. S34 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-5)

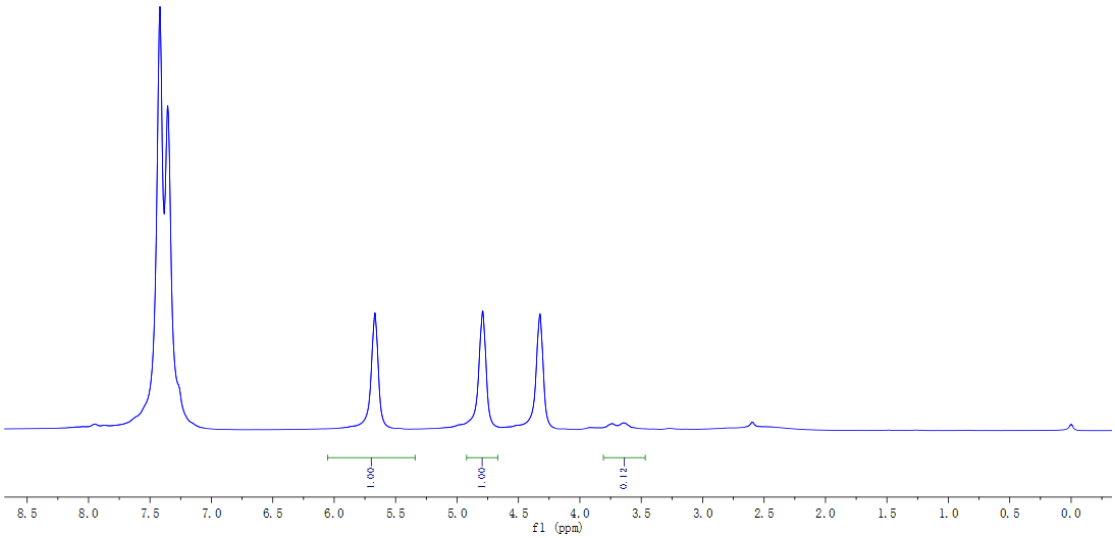

Fig. S35 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-6)

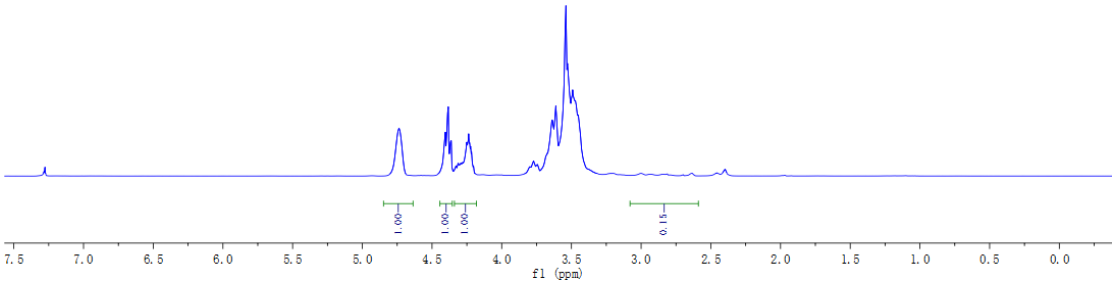

Fig. S36 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-7)

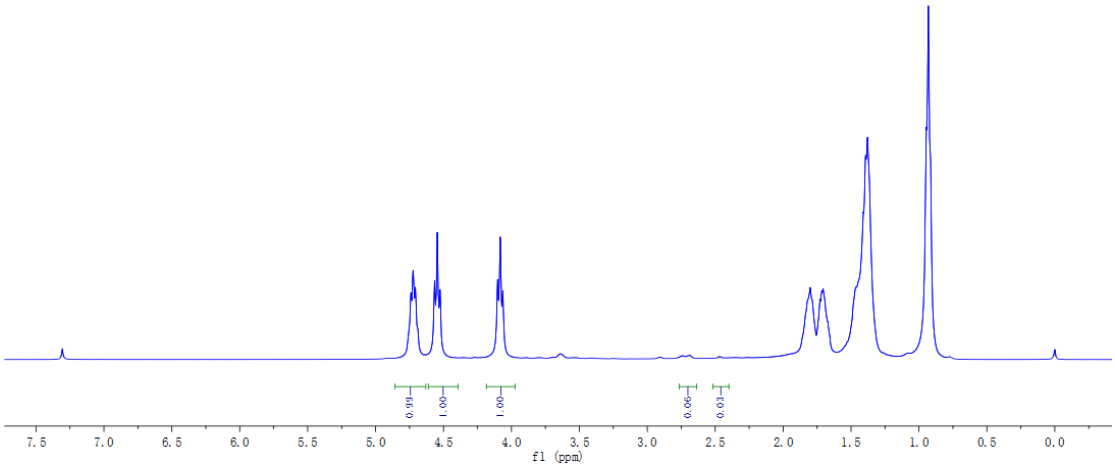

Fig. S37 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-8)

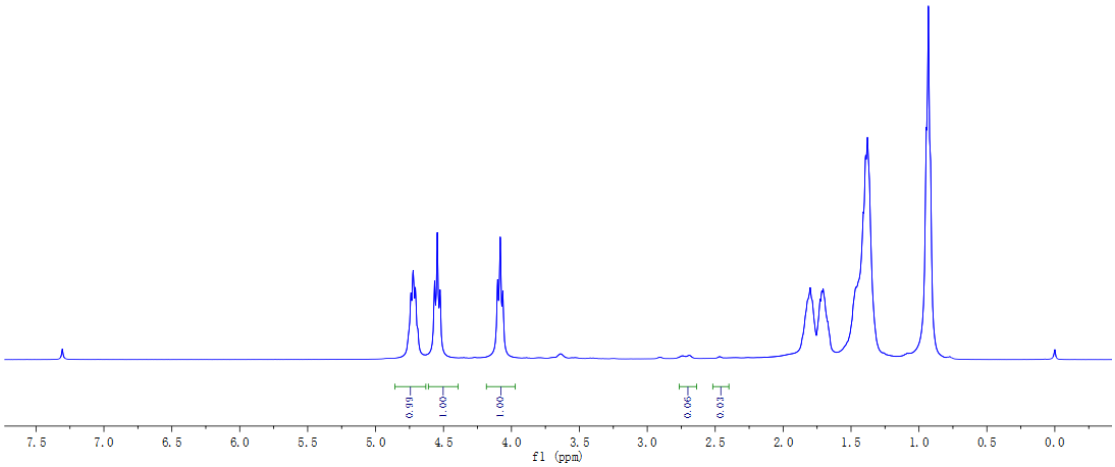

Fig. S38 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-9)

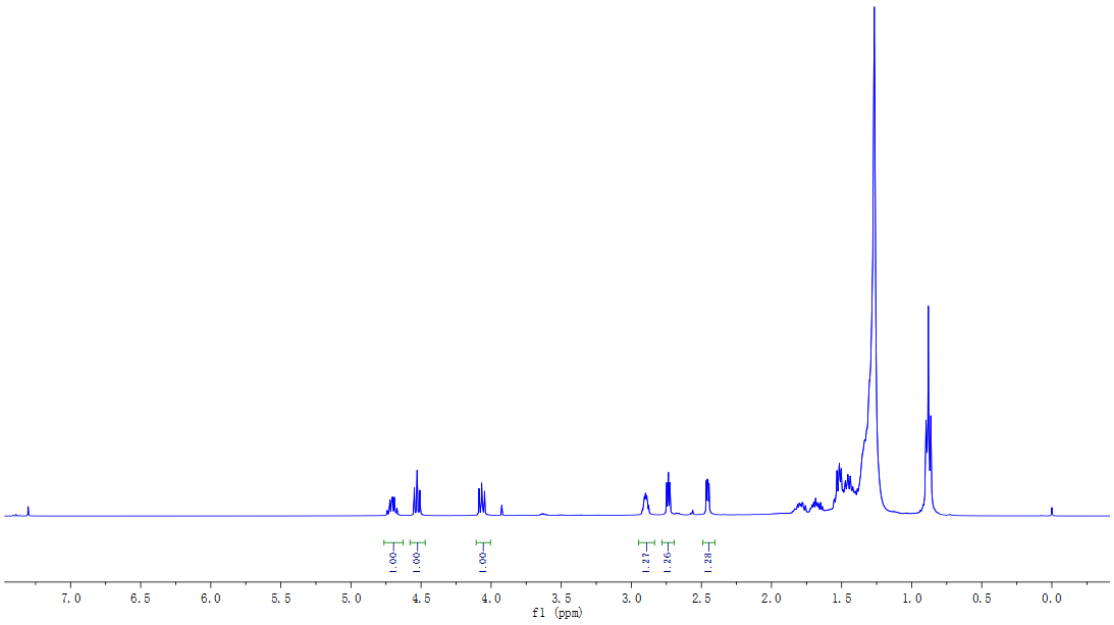

Fig. S39 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-10)

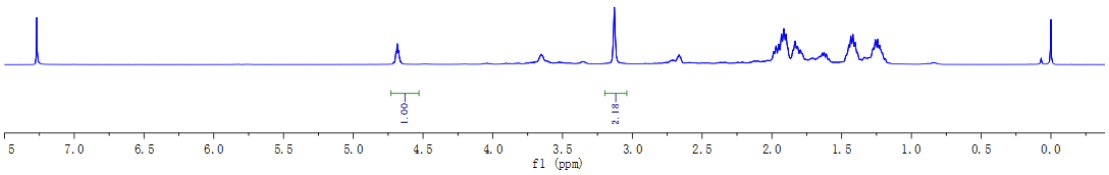

Fig. S40 The chemical shift and area of mixture of epoxide and cyclic carbonate (Table 2-11)

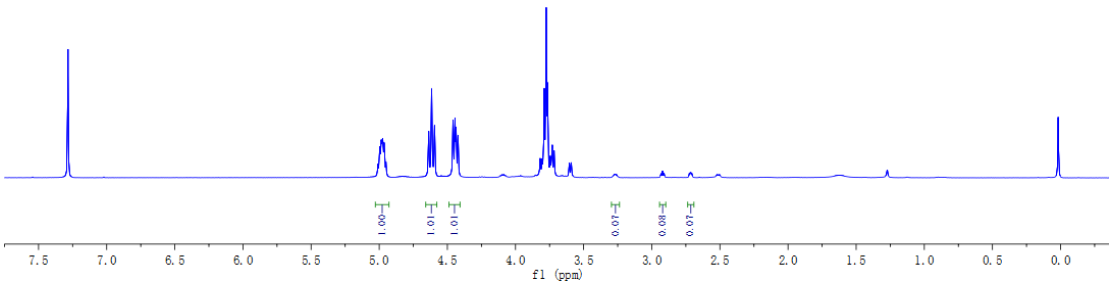

Fig. S41 The chemical shift and area of mixture of ECH and cyclic carbonate (R1)

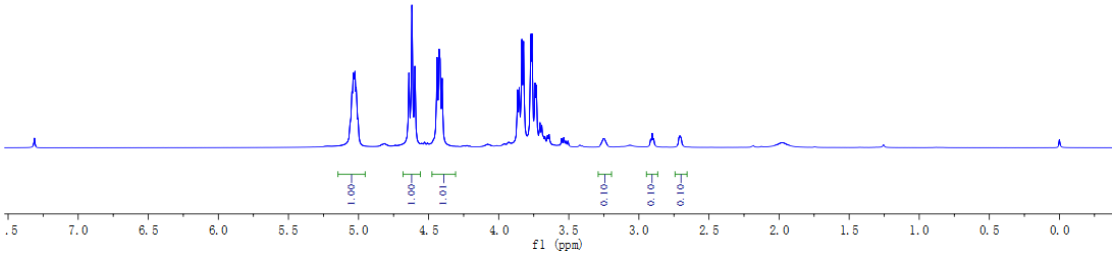

Fig. S42 The chemical shift and area of mixture of ECH and cyclic carbonate (R2)

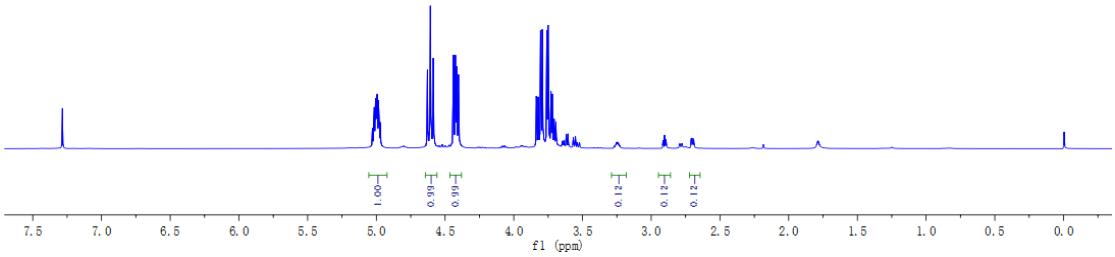

Fig. S43 The chemical shift and area of mixture of ECH and cyclic carbonate (R3)

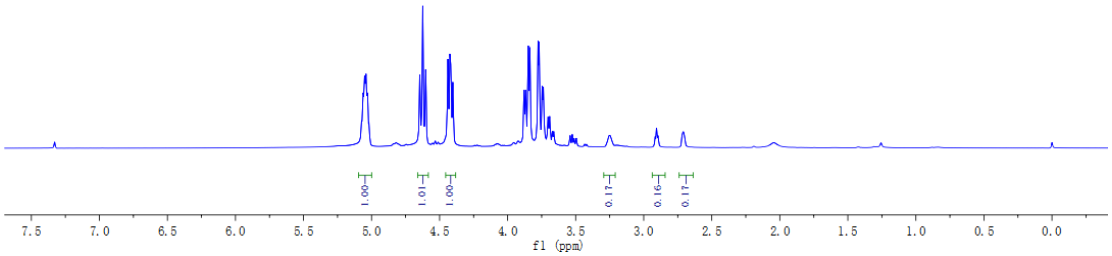

Fig. S44 The chemical shift and area of mixture of ECH and cyclic carbonate (R4)

4. Recycling diagram of COCP-OH

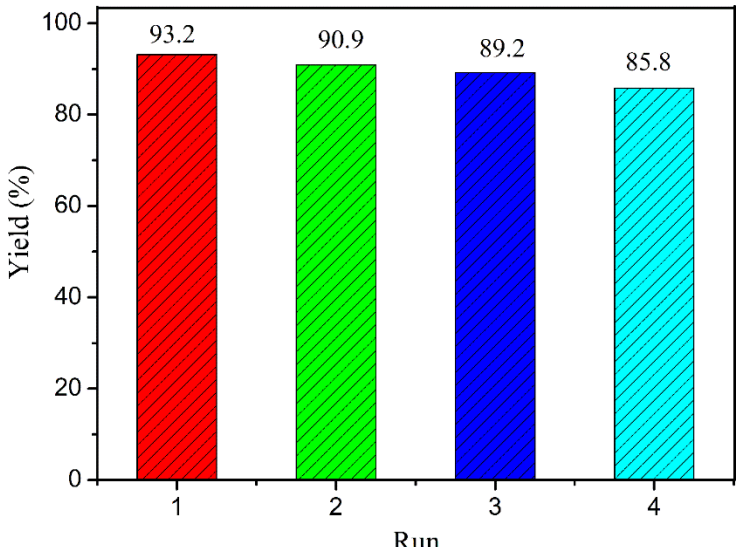

Fig. S45 Reusability study for COCP-OH: Reaction condition: ECH (10mmol), COCO-OH (71 mg), KI (12.2 mg), CO_2 (1 bar), 70 ℃, 24 h. Product conversion was determined by ^{1}H NMR (Fig. S40–Fig. S43).

5. FT-IR spectra

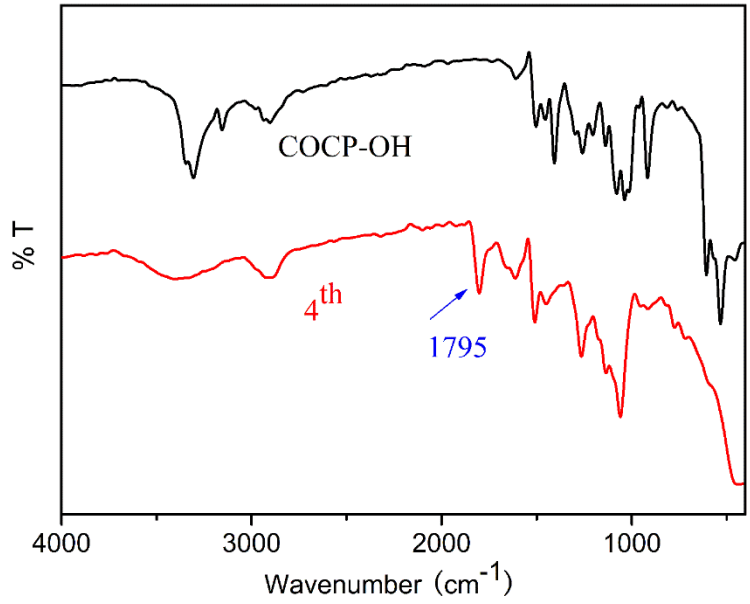

Fig. S46 The FT-IR spectra of COCP-OH and the 4th recycled sample.