

Supporting information Figure Captions:

S.Fig.1 Analysis of standard curve

S.Fig.2 UV-Vis characterizations of TBAC: PEG: FeCl₃

S.Fig.3 UV-Vis characterizations of TBAC: PEG: ZnCl₂

S.Fig.4 UV-Vis characterizations of TBAC: PEG

S.Fig.5 Effect of the metal ions of MDESs

S.Fig.6 Multiple extraction

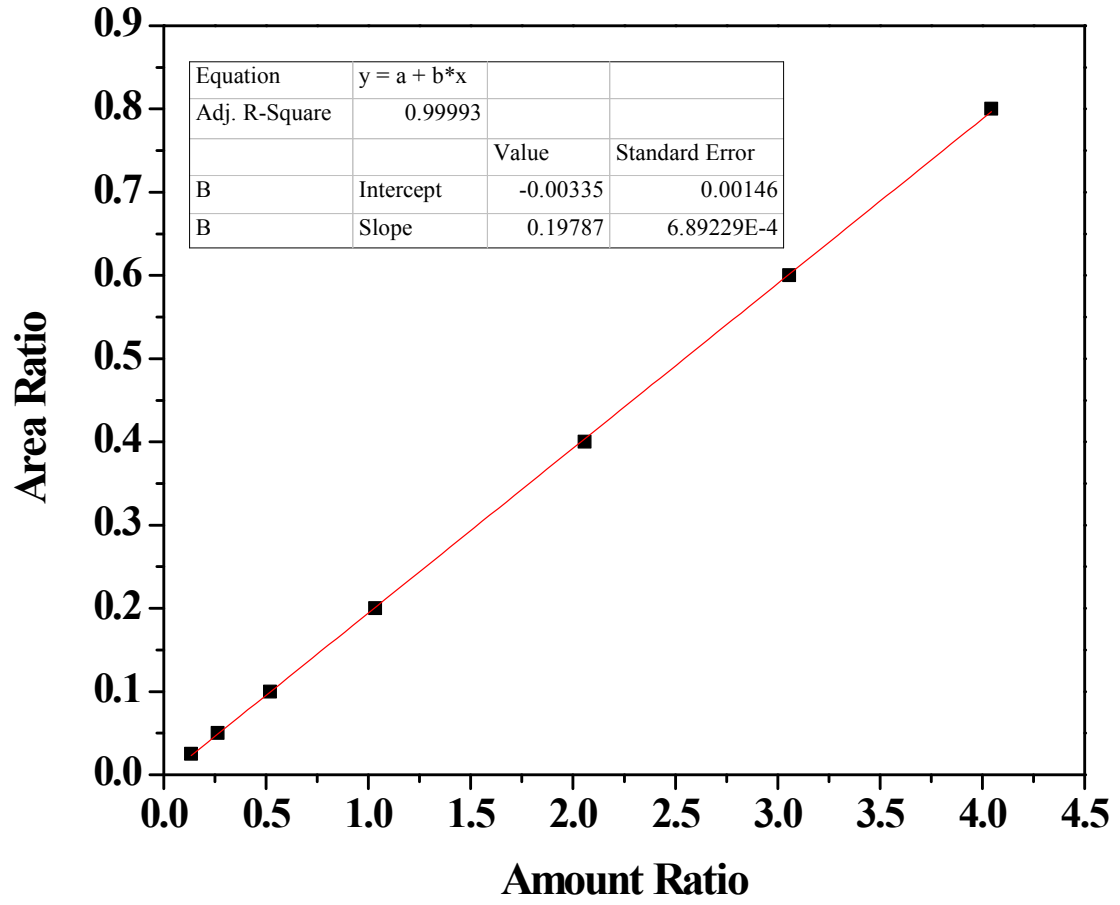
S.Fig.7 Part 1 FT-IR characterizations of TBAC: PEG: ZnCl₂

S.Fig.8 Part 1 FT-IR characterizations of TBAC: PEG

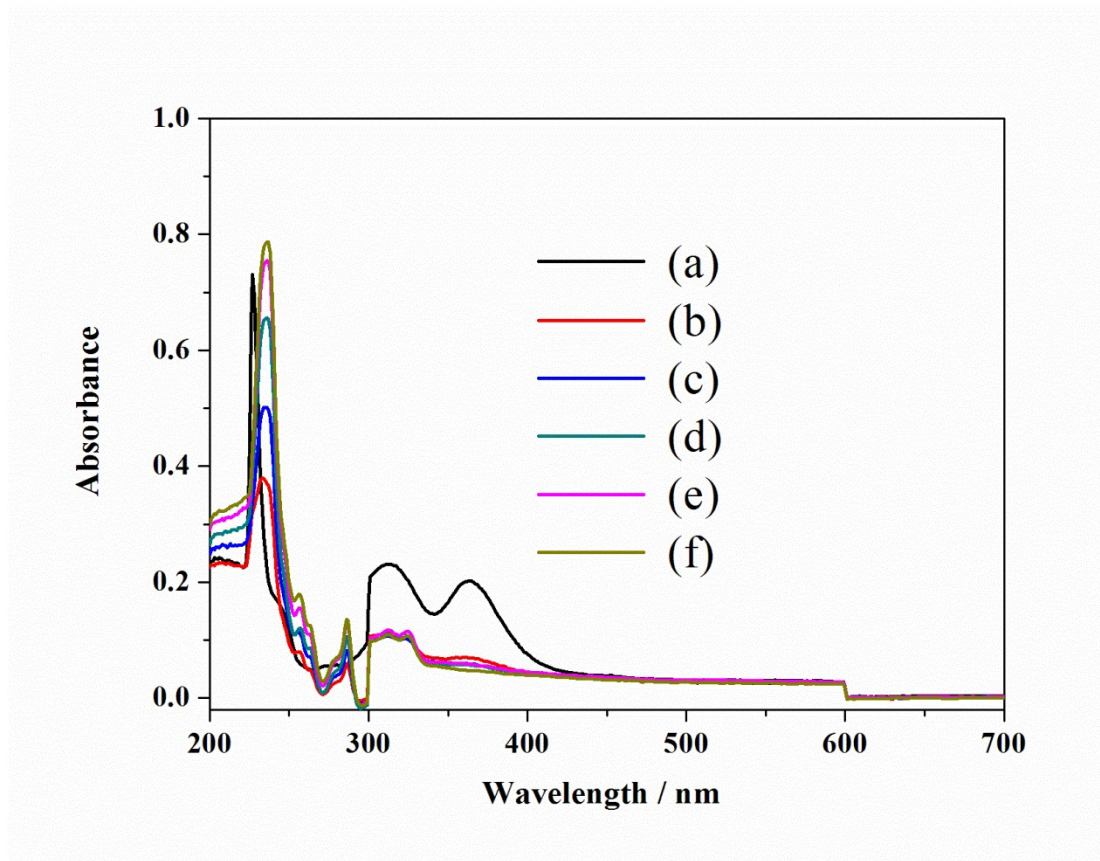
S.Fig.9 Part 2 FT-IR characterizations of TBAC: PEG: ZnCl₂

S.Fig.10 Part 2 FT-IR characterizations of TBAC: PEG

S.Fig.1



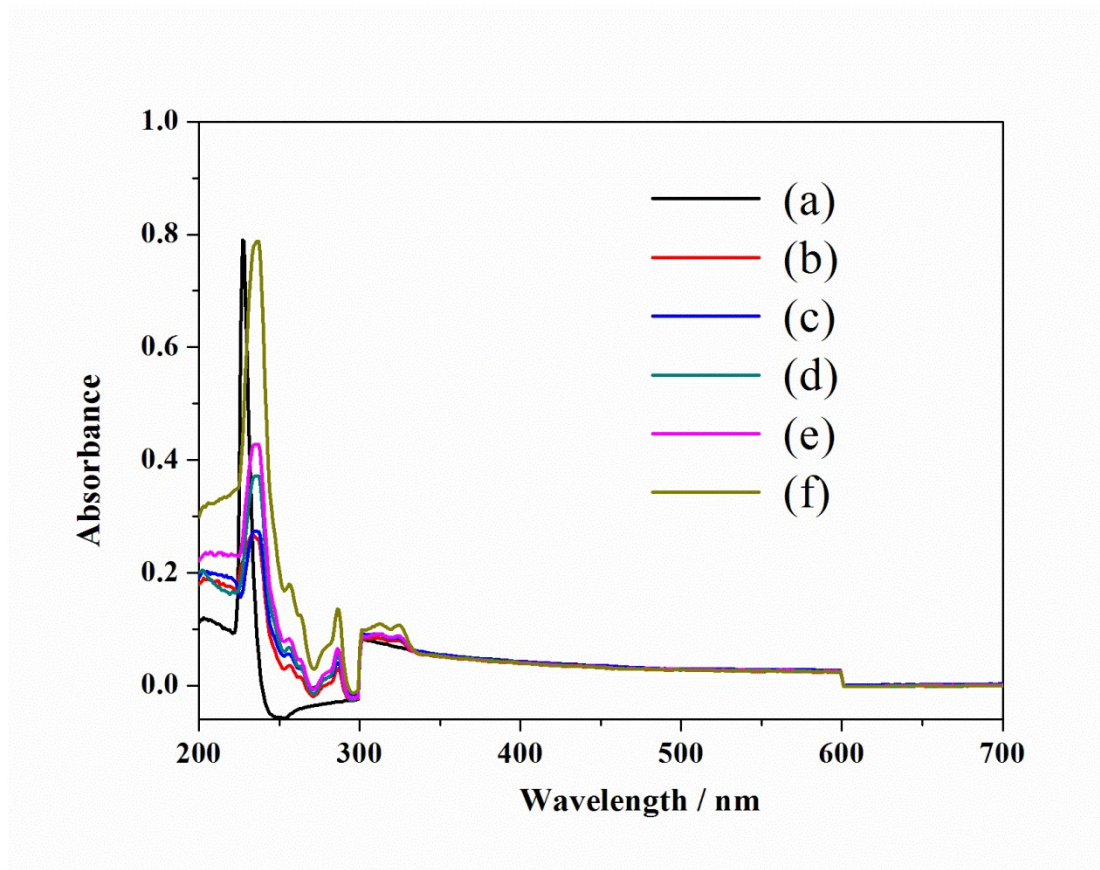
S.Fig.2



UV-Vis of different mass ratio of TBAC: PEG: FeCl₃ with DBT

(a) 1:0 (b) 1:0.1 (c) 1:0.25 (d) 1:0.5 (e) 1:0.75 (f) 0:1

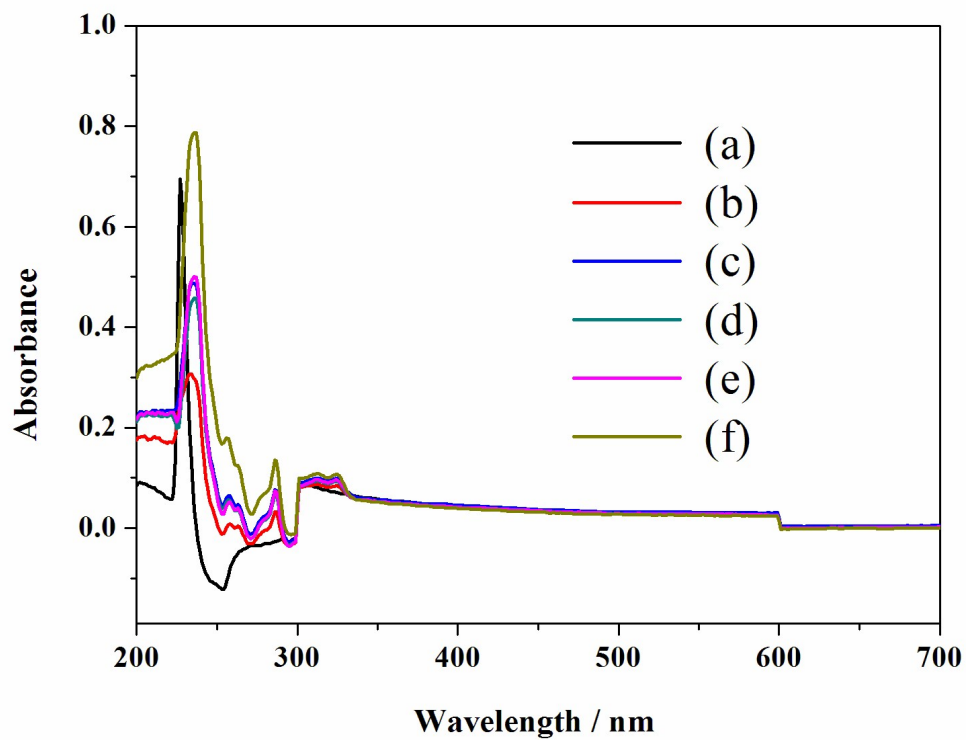
S.Fig.3



UV-Vis of different mass ratio of TBAC: PEG: ZnCl₂ with DBT

(a) 1:0 (b) 1:0.1 (c) 1:0.25 (d) 1:0.5 (e) 1:0.75 (f) 0:1

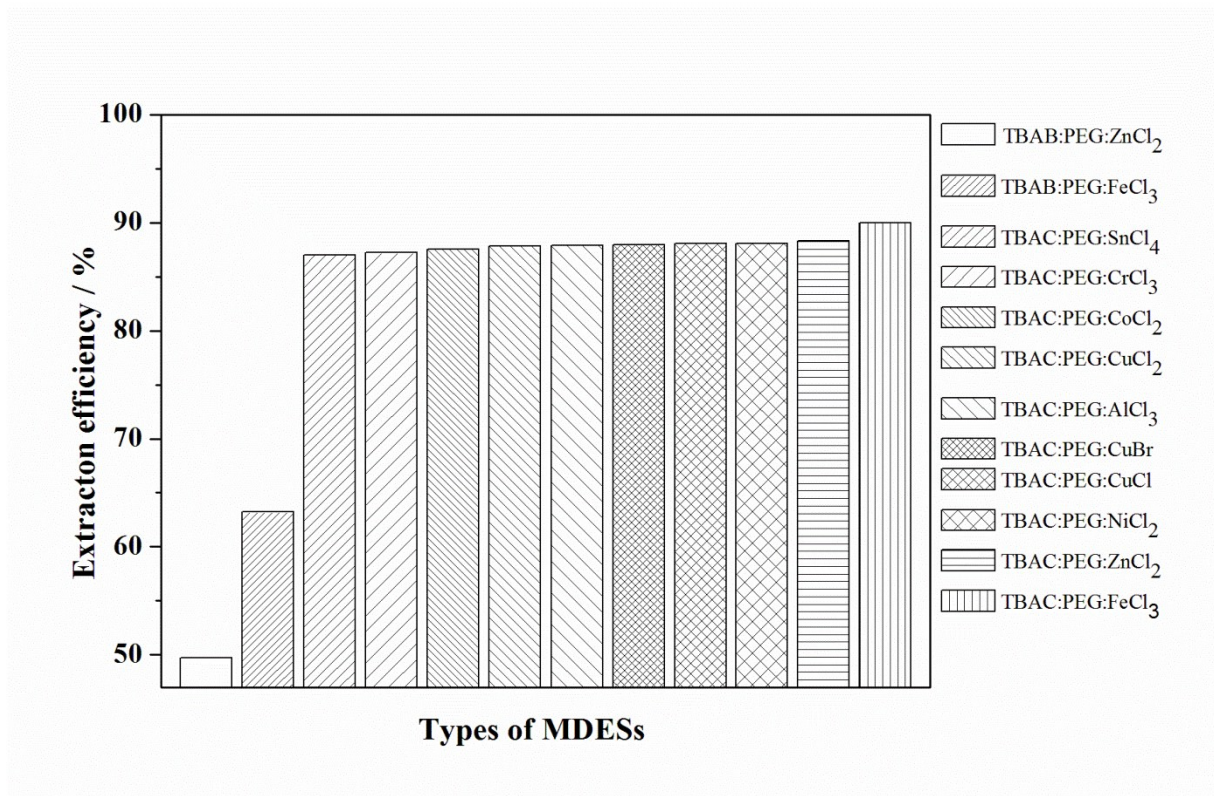
S.Fig.4



UV-Vis of different mass ratio of TBAC: PEG with DBT

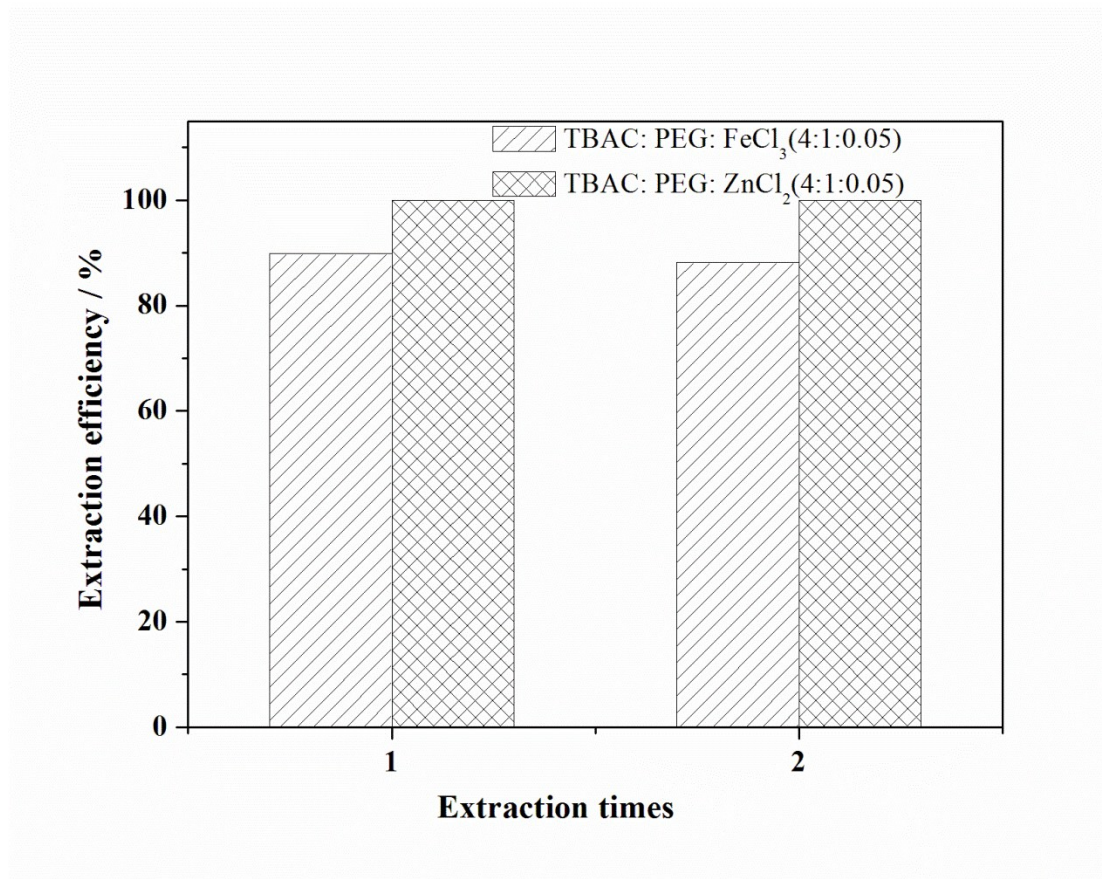
(a) 1:0 (b) 1:0.1 (c) 1:0.25 (d) 1:0.5 (e) 1:0.75 (f) 0:1

S.Fig.5

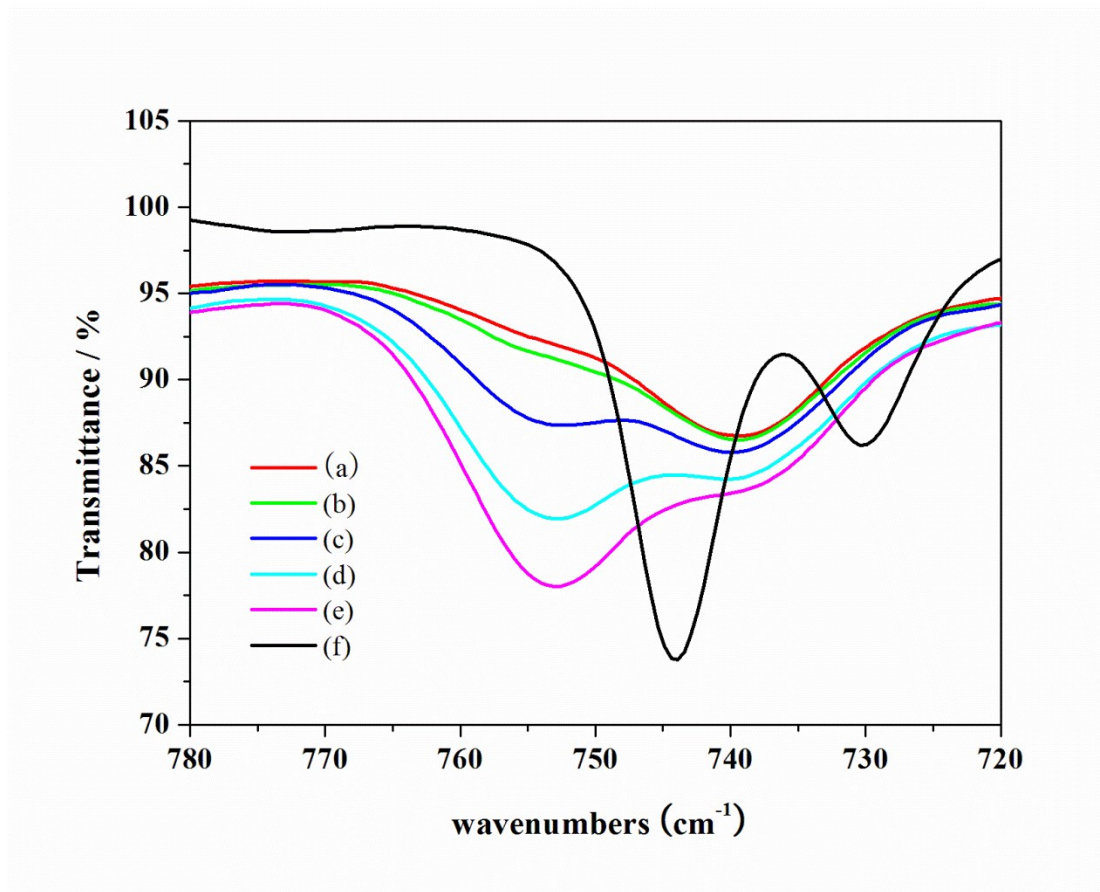


Different type of metal ions were added in MDESs as the mass ratio of 4:1:0.05 to figure out the influence of metal chloride on extraction. The desulfurization efficiency of the same mass ratio of MDESs was shown in S.Fig.4. For the metal chloride the extraction efficiency was as follows: $\text{FeCl}_3 > \text{ZnCl}_2 > \text{NiCl}_2 > \text{CuCl} > \text{CuBr} > \text{AlCl}_3 > \text{CuCl}_2 > \text{CoCl}_2 > \text{CrCl}_3 > \text{SnCl}_4$. As seen in S.Fig.4, except for FeCl_3 , other metal ions has no obvious change on desulfurization efficiencies compared with our previous work.^[33] The addition of FeCl_3 , the extraction desulfurization efficiency can increase by about 7%. This is a great imporment of for the specific extraction desulfurization process. So, the type of metal ions has great influnence on MDESs desulfurization efficiencies.

S.Fig.6



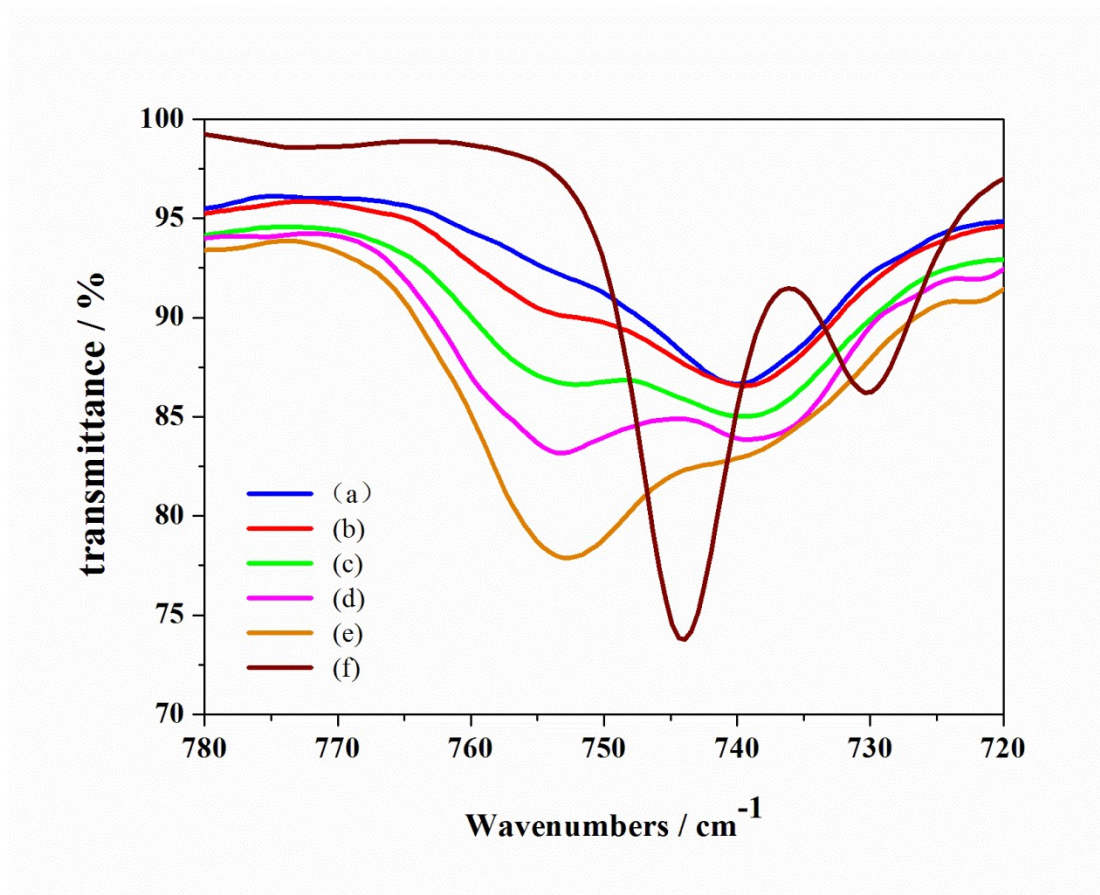
S.Fig.7



FT-IR of different mass ratio of TBAC: PEG: ZnCl₂ with DBT

(a) 1:0 (b) 1:0.1 (c) 1:0.25 (d) 1:0.5 (e) 1:0.75 (f) 0:1

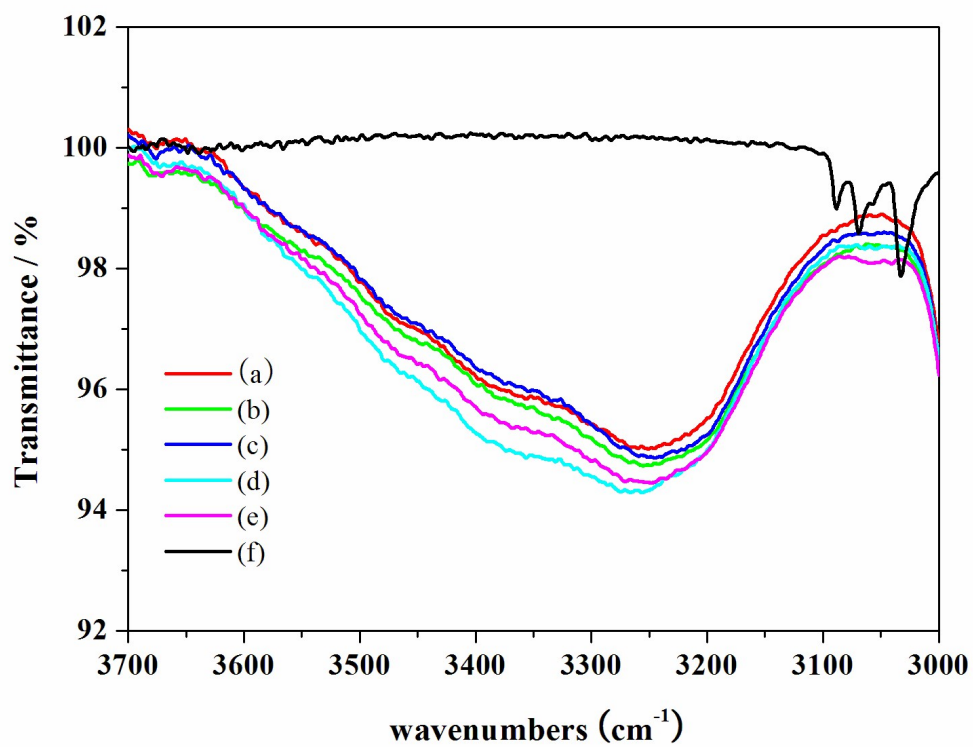
S.Fig.8



FT-IR of different mass ratio of TBAC: PEG with DBT

(a) 1:0 (b) 1:0.1 (c) 1:0.25 (d) 1:0.5 (e) 1:0.75 (f) 0:1

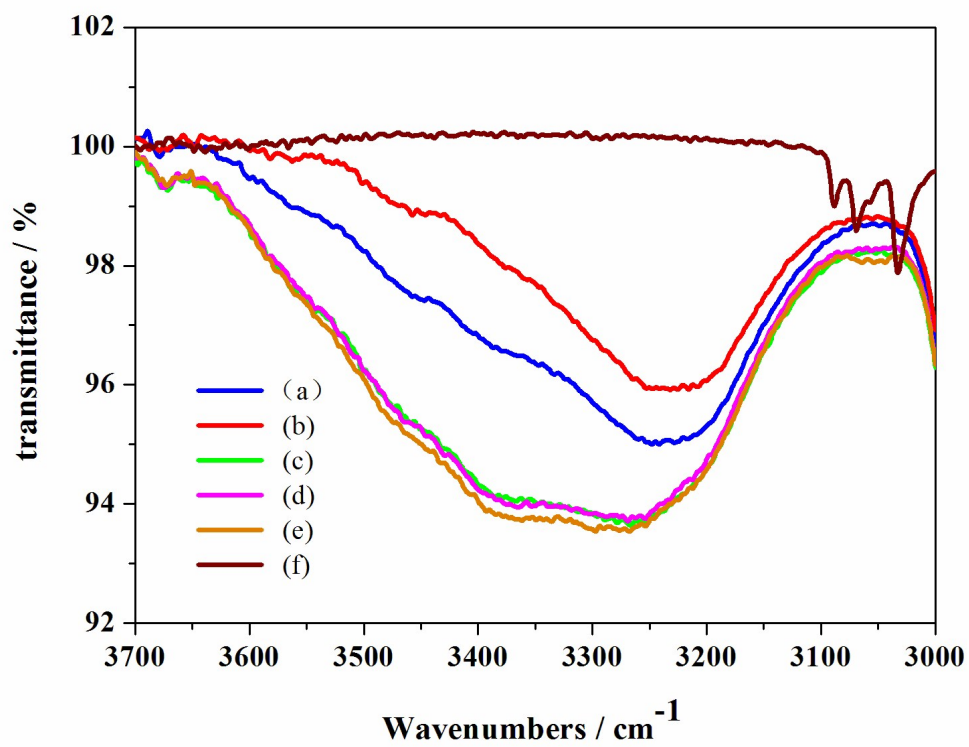
S.Fig.9



FT-IR of different mass ratio of TBAC: PEG: ZnCl₂ with DBT

(a) 1:0 (b) 1:0.1 (c) 1:0.25 (d) 1:0.5 (e) 1:0.75 (f) 0:1

S.Fig.10



FT-IR of different mass ratio of TBAC: PEG with DBT

(a) 1:0 (b) 1:0.1 (c) 1:0.25 (d) 1:0.5 (e) 1:0.75 (f) 0:1