**Supporting Information**

# Natural eggshell waste as an eco-friendly and low-cost catalyst for the synthesis of *α, β*-unsaturated compounds

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# Experimental

## Materials and methods

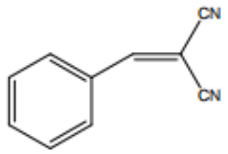
## Chemicals

Three natural eggshells were collected from the restaurant, which were washed by deionized water to remove the soluble impurities and keratin. After being dried at 80 $^{o}$C for 24 h, it was crushed using universal grinder with the size smaller than 48 μm. All others chemicals with analytical grade were purchased from Shanghai Macklin Biochemical Co., Ltd, China, and used without further treatment.

## Characterizations

Rigaku Utima IV (Rigaku Corporation, Osaka, Japan) was used to record the X-ray diffraction (XRD) patterns with a step of 0.02 using Cu $K_{\alpha}$ radiation (λ=1.5418 Å) at 40 kV and 40 mA. PANalytical Axios (MAX) energy dispersive X-ray fluorescence spectrometer (XRF) was used to analyze the elemental composition of the eggshell waste. Nicolet 380 Fourier Transform-Infrared (FT-IR) spectrophotometer (Thermo Electron Corporation, USA) was used to record the FT-IR spectra in the range of 500–4000 $cm^{-1}$. Scanning electron microscope (SEM) (JSM-6700F, JEOL) was used to observe the morphology of the eggshell waste. Hammett indicator method was used to measure the basicity strength (H_) of the eggshell waste catalyst using bromothymol blue (H_ = 7.2), phenolphthalein (H_ = 9.8) and dinitroaniline (H_ = 15.0) as Hammett indicators. Melting points and $^{1}$H NMR spectra were determined on a XT-4 micromelting point apparatus (Beijing Taike Instrument Company, China) and EFT-60 NMR spectrometer (Anasazi Instruments, USA), respectively.

Compound 1



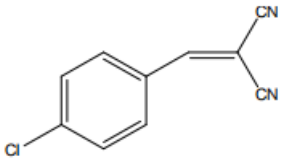

7.947
7.932
7.810
7.680
7.665
7.650
7.589
7.573
7.558

2.11
1.00
1.02
2.09

8.00
7.50

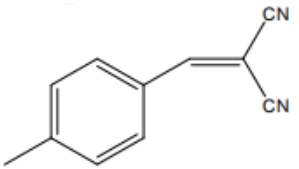
60
50
40
30
20
10
0

Compound 2


CN
CN
Cl

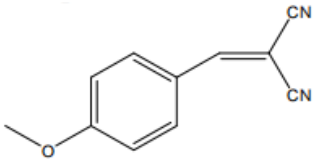

7.938
7.794
7.737
7.578
7.436
7.260
0.65
2.31
2.00
20
10
0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5

Compound 3


CN
CN

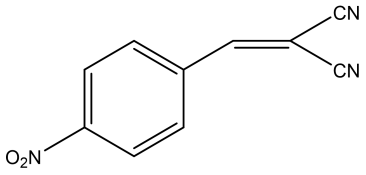

7.881
7.734
7.394
7.260
2.450
1.14
2.11
1.52
3.17
100
80
60
40
20
0
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
f1 (ppm)

Compound 4


CN
CN
O


7.986
7.842
7.650
7.260
7.080
6.937
3.912
40
20
0
0.90
2.12
1.96
3.00
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2

Compound 5



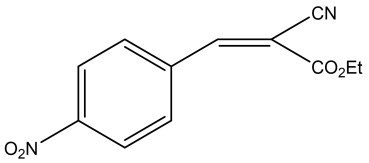

8.473
8.328
8.133
7.986
7.885
7.260

2.00
1.47
1.76

10
0

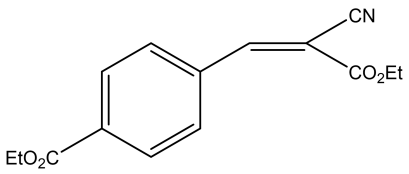
11
10
9
8
7
6

# Compound 7


CN
CO2Et
O2N


8.423
8.289
8.182
8.038
7.261
4.589
4.473
4.356
4.240
1.520
1.403
1.286
1.27
1.27
1.96
2.05
3.42
30
20
10
0
12
11
10
9
8
7
6
5
4
3
2
1
0
−1

# Compound 8


CN
CO2Et
EtO2C


8.237
8.135
7.998
7.840
7.702
7.260
4.580
4.462
4.344
4.226
1.604
1.515
1.397
1.278
1.28
2.08
2.40
1.50
1.52
2.54
2.64
30
20
10
0
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1