Electronic Supplementary Material (ESI) for RSC Advances.


# Supplementary Information

## Efficient production of acrylic acid by dehydration of lactic acid over $BaSO_4$ with crystal defects

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Table S1. Catalytic performance and carbon balance of all the catalysts [a]

| Catalyst | WHSV ($h^{-1}$) | Conversion (%) | Selectivity (%) | | | | | Carbon balance (%) |
|---|---|---|---|---|---|---|---|---|
| | | | AA | AD | AcOH | PA | Carbon deposits | |
| Commercial | 2.5 | 29.8 | 28.8 | 41.2 | 8.2 | 4.5 | 0.3 | 83.0 |
| Co-pre | 2.5 | 69.5 | 65.8 | 23.2 | 5.1 | 1.9 | 0.3 | 96.3 |
| Water/ult | 2.5 | 70.1 | 69.7 | 18.0 | 3.9 | 1.5 | 0.3 | 93.4 |
| EtOH/ult-0h-500 | 2.5 | 77.6 | 78.9 | 12.7 | 3.2 | 2.2 | 0.3 | 97.3 |
| EtOH/ult-0h-500 | 5.0 | 66.1 | 76.7 | 16.4 | 2.9 | 2.0 | 0.2 | 98.2 |
| EtOH/ult-1h-500 | 5.0 | 56.2 | 70.5 | 18.2 | 3.0 | 3.0 | 0.2 | 94.9 |
| EtOH/ult-2h-500 | 5.0 | 52.6 | 65.7 | 17.2 | 3.2 | 2.7 | 0.2 | 89.0 |
| EtOH/ult-24h-500 | 5.0 | 51.7 | 58.6 | 15.2 | 2.7 | 1.4 | 0.2 | 78.1 |
| EtOH/ult-0h-350 | 5.0 | 72.9 | 66.4 | 17.4 | 3.1 | 1.0 | 0.3 | 88.2 |
| EtOH/ult-0h-600 | 5.0 | 45.8 | 59.2 | 20.5 | 3.5 | 2.3 | 0.2 | 85.7 |
| EtOH/ult-0h-700 | 5.0 | 28.2 | 59.4 | 21.3 | 6.6 | 3.8 | 0.1 | 91.2 |

[a] Conditions: reaction temperature 350 °C, feed flow rate: 1.2 mL/h, LA feedstock: 20 wt% in water, carrier gas $N_2$: 30 mL/min.

Table S2. Catalytic performance at different reaction temperatures[a]

| Reaction temperature (°C) | Conversion (%) | Selectivity (%) | | | | Carbon balance (%) |
|---|---|---|---|---|---|---|
| | | AA | AD | AcOH | PA | |
| 300 | 51.6 | 33.5 | 33.6 | 1.7 | 1.2 | 70.1 |
| 350 | 77.6 | 78.9 | 12.7 | 3.2 | 2.2 | 97.3 |
| 400 | 93.4 | 67.7 | 18.0 | 5.6 | 4.8 | 96.4 |

[a] Conditions: EtOH/ult-0h-500, WHSV = 2.5 $h^{-1}$, feed flow rate: 1.2 mL/h, LA feedstock: 20 wt% in water, carrier gas $N_2$: 30 mL/min, TOS = 4-9 h.

Table S3. Catalytic performance at different WHSV[a]

| WHSV ($h^{-1}$) | Conversion (%) | Selectivity (%) | | | | Carbon balance (%) |
|---|---|---|---|---|---|---|
| | | AA | AD | AcOH | PA | |
| 0.8 | 97.5 | 77.7 | 13.5 | 1.2 | 1.0 | 94.0 |
| 1.3 | 88.9 | 78.8 | 14.6 | 3.5 | 1.9 | 99.3 |
| 2.5 | 77.6 | 78.9 | 12.7 | 3.2 | 2.2 | 97.3 |
| 5.0 | 66.1 | 76.7 | 16.4 | 2.9 | 2.0 | 98.2 |

[a] Conditions: EtOH/ult-0h-500, reaction temperature 350 °C, feed flow rate: 1.2 mL/h, LA feedstock: 20 wt% in water, carrier gas $N_2$: 30 mL/min, TOS = 4-9 h.

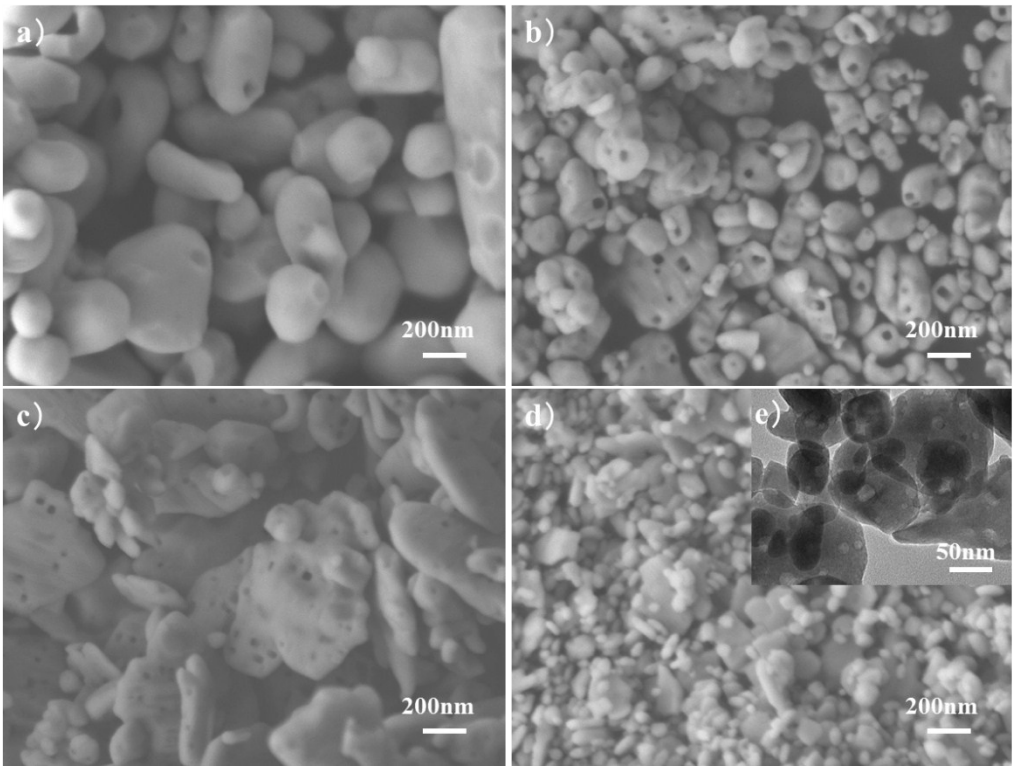


Figure S1. SEM images of $BaSO_4$ catalysts prepared with different methods

(a) Commercial, (b) Co-pre, (c) Water/ult, (d) EtOH/ult-0h-500, and (e) TEM image of EtOH/ult-0h-500

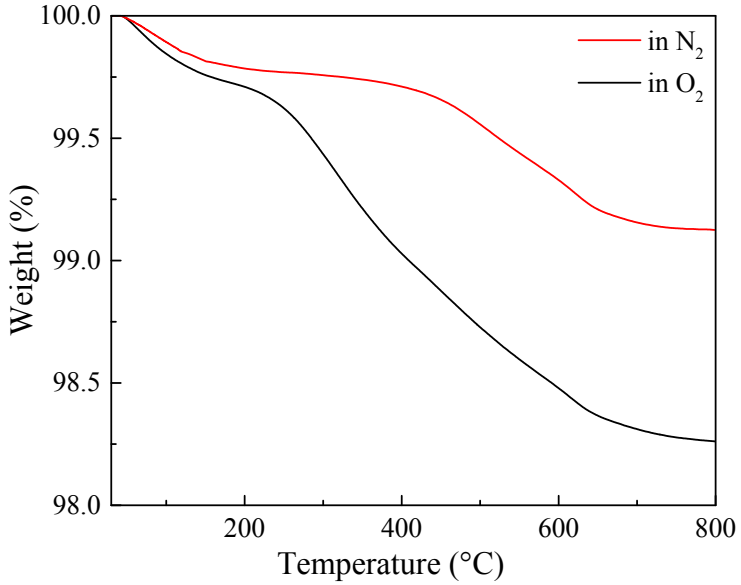


Figure S2. TGA profiles of EtOH/ult-350 in $N_2$ and $O_2$ atmosphere

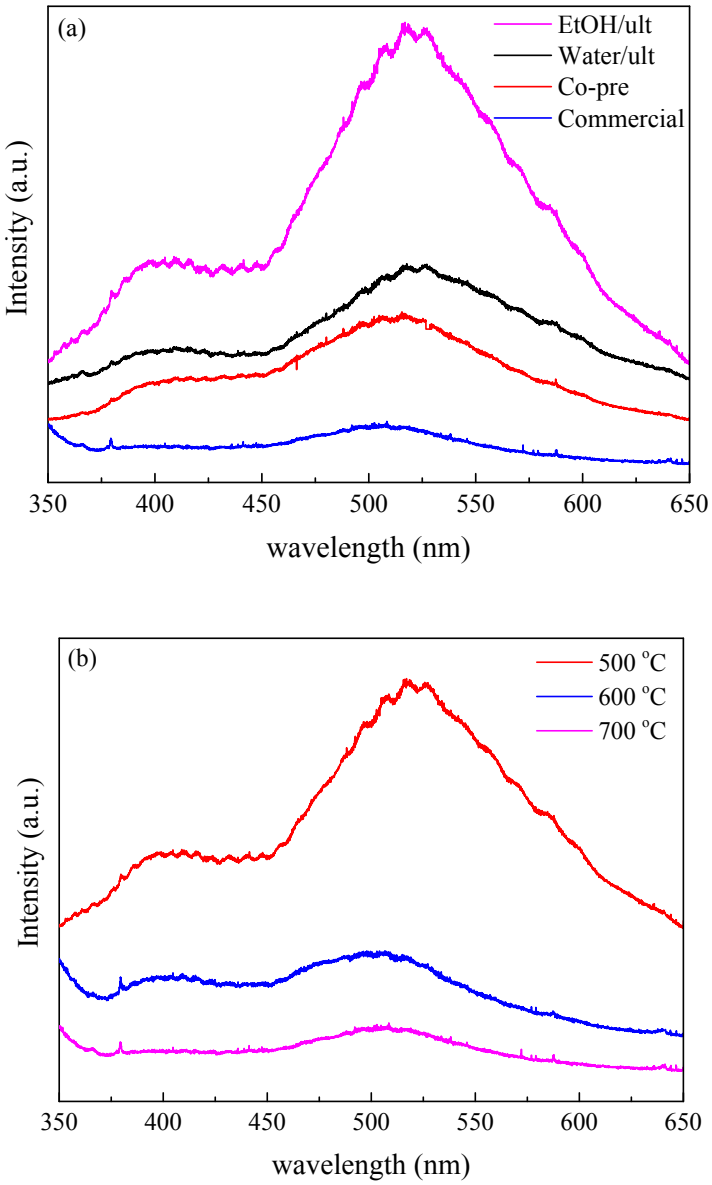


Figure S3. Photoluminescence (PL) spectra of EtOH/ult (a) prepared with different methods and (b) calcined at different temperatures

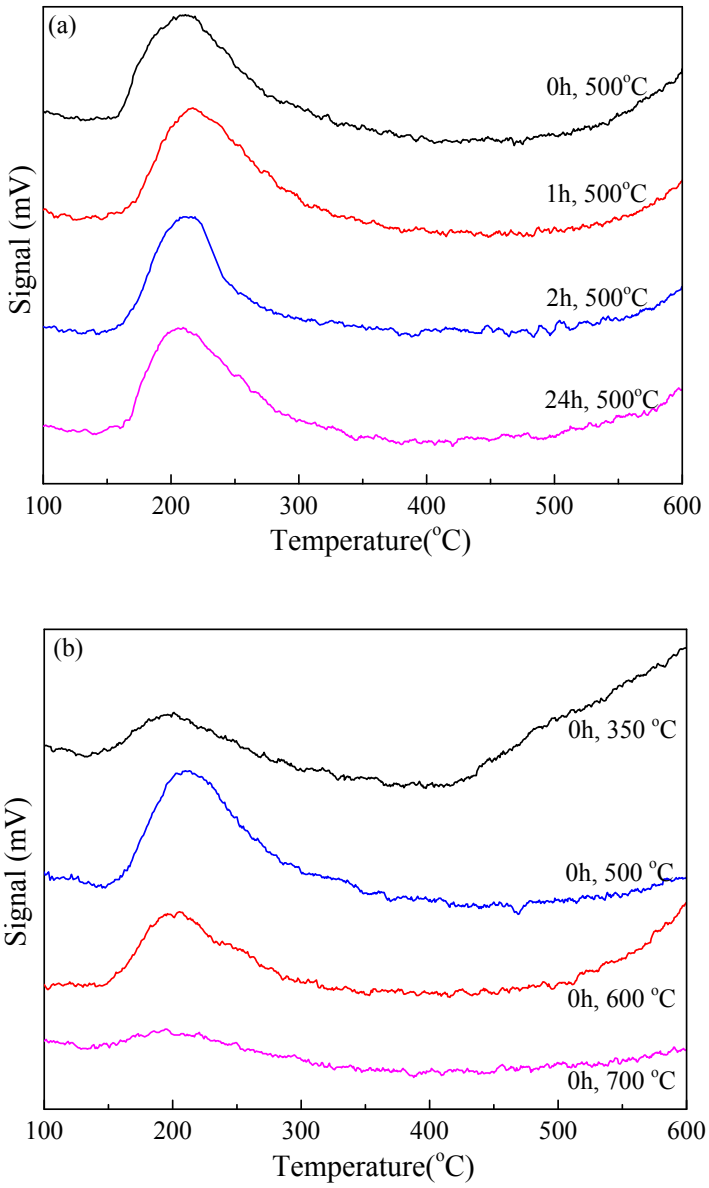


Figure S4. $NH_3$-TPD profiles of $BaSO_4$ catalysts (a) with different aging time and (b) calcined at different temperature

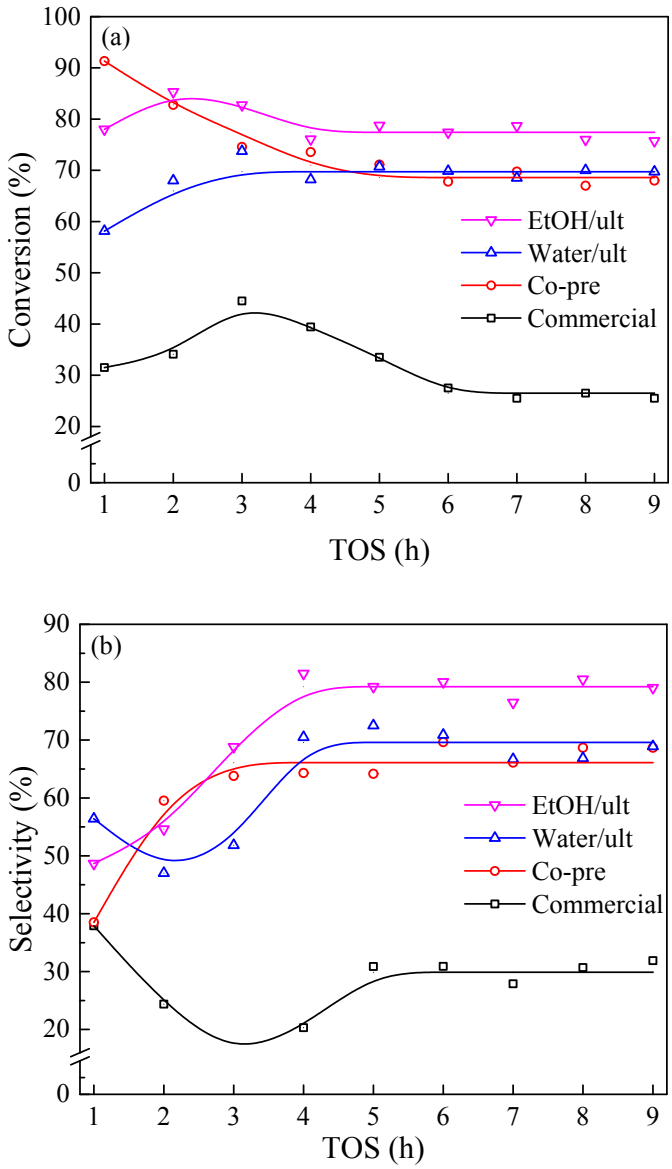


Figure S5. Performance of $BaSO_4$ catalysts prepared with different methods.

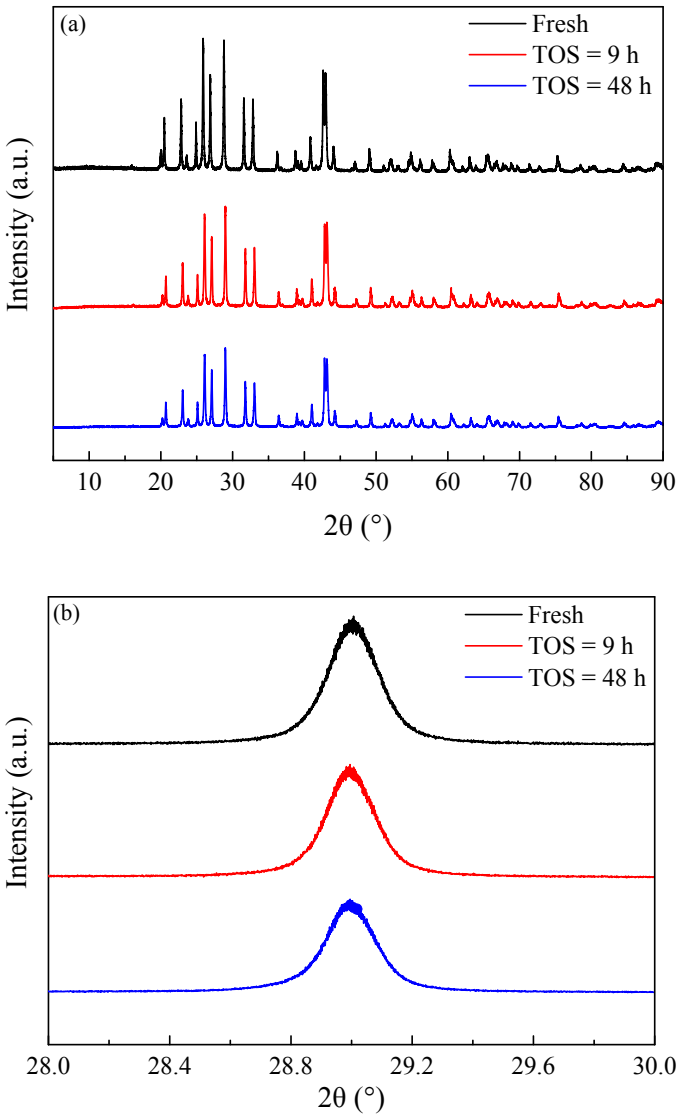


Figure S6. (a) XRD patterns and (b) enlarged (121) diffraction peaks of the fresh and spent EtOH/ult-0h-500 catalysts.