**Supporting Information**

**Solidthermal and Fast Synthesis of MgAl-hydrotalcite Nanosheet and Their Applications in Catalytic Elimination of Carbonyl Sulfide and Hydrogen Sulfide**

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**Experimental section**

**Chemicals and regents**

MgAl-LDHs sample, Al2O3 (AR), Fe2O3 (≥99%), TiO2 (AR, ≥99%) were purchased from Aldrich, Sinopharm group Co. Ltd., China, Adamas and Macklin, respectively.

**Preparation of compared samples**

g-C3N4 solid base was prepared as the literature1. Briefly, 10 g of dicyandiamide (Sinopharm Chemical Reagent, ≥98.0 %) was heated to 600 °C at a rate of 2.3 °C/ min and calcined at this temperature for 4 h in an NH3 flow (60 mL/ min). The obtained product is herein denoted as g-C3N4.

K2CO3@γ-Al2O3 compared catalystwas prepared as the literature2. Briefly, γ-Al2O3 support was impregnated with 5% mass content of K2CO3 solution and was placed in an ultrasonic bath for 30 min. Finally, the material was dried at 120 °C for 3–4 h, and is denoted herein as K2CO3@γ-Al2O3.

CeO2 compared catalystwas prepared as the literature3. Typically, 1.3 g of Ce(NO3)3·6H2O and 4 g of urea were dissolved in 50 mL of distilled water. Then, 6 mL of NH3·H2O was slowly introduced, the mixture was stirred for 25 min, which was subsequently transferred into a 100 mL Teflon-lined autoclave and treated at 150 °C for 24 h. The pristine product was obtained from centrifugation, washing with ultrapure water and ethanol for three times, and drying at 90 °C overnight. Before use, the CeO2 was calcined at 500 °C for 4 h under air condition.

For comparison, MA-LDHs-cp was prepared by co-precipitation method as the literature4. Briefly, an aqueous solution containing Mg(NO3)2·6H2O and Al(NO3)3·9H2O (Mg/Al molar ratio=3/1) was slowly into the sodium carbonate aqueous solution at room temperature, the reaction mixture turn cloudy and precipitate was formed. The pH of the solution was adjusted to 10 ± 0.5 by using sodium hydroxide aqueous solution. After aging at 90 °C for 24 h under stirring. The MA-LDHs-cp can be obtained from filteration, washing with abundant deionized water, and drying at 100 °C for another 12 h.

**Table S1** Different O species content of MA-LDHs-x samples according to O1s spectra.

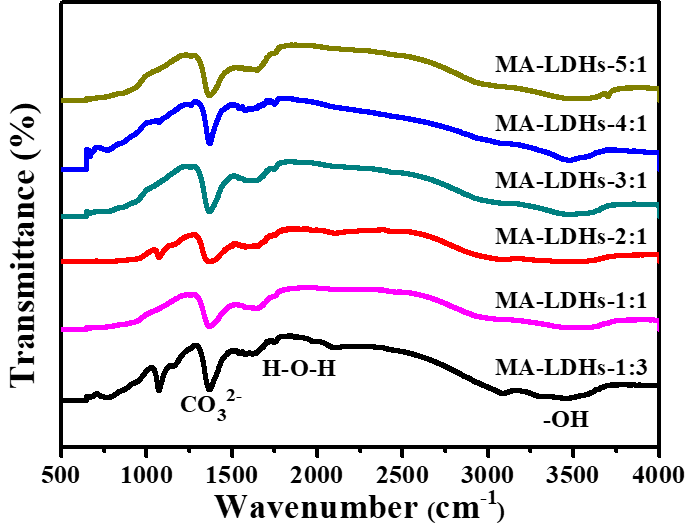
|  |  |  |  |
| --- | --- | --- | --- |
| Sample | M-OH (%) | H2O (%) | M-O (%) |
| MA-LDHs-1:3 | 41.91 | 32.56 | 23.53 |
| MA-LDHs-1:1 | 46.51 | 23.89 | 29.6 |
| MA-LDHs-2:1 | 53.44 | 21.95 | 24.61 |
| MA-LDHs-3:1 | 56.36 | 26.48 | 17.16 |
| MA-LDHs-4:1 | 51.41 | 31.46 | 17.13 |
| MA-LDHs-5:1 | 48.37 | 27.68 | 23.95 |

**Table S2** Comparison of different catalysts used for COS hydrolysis.

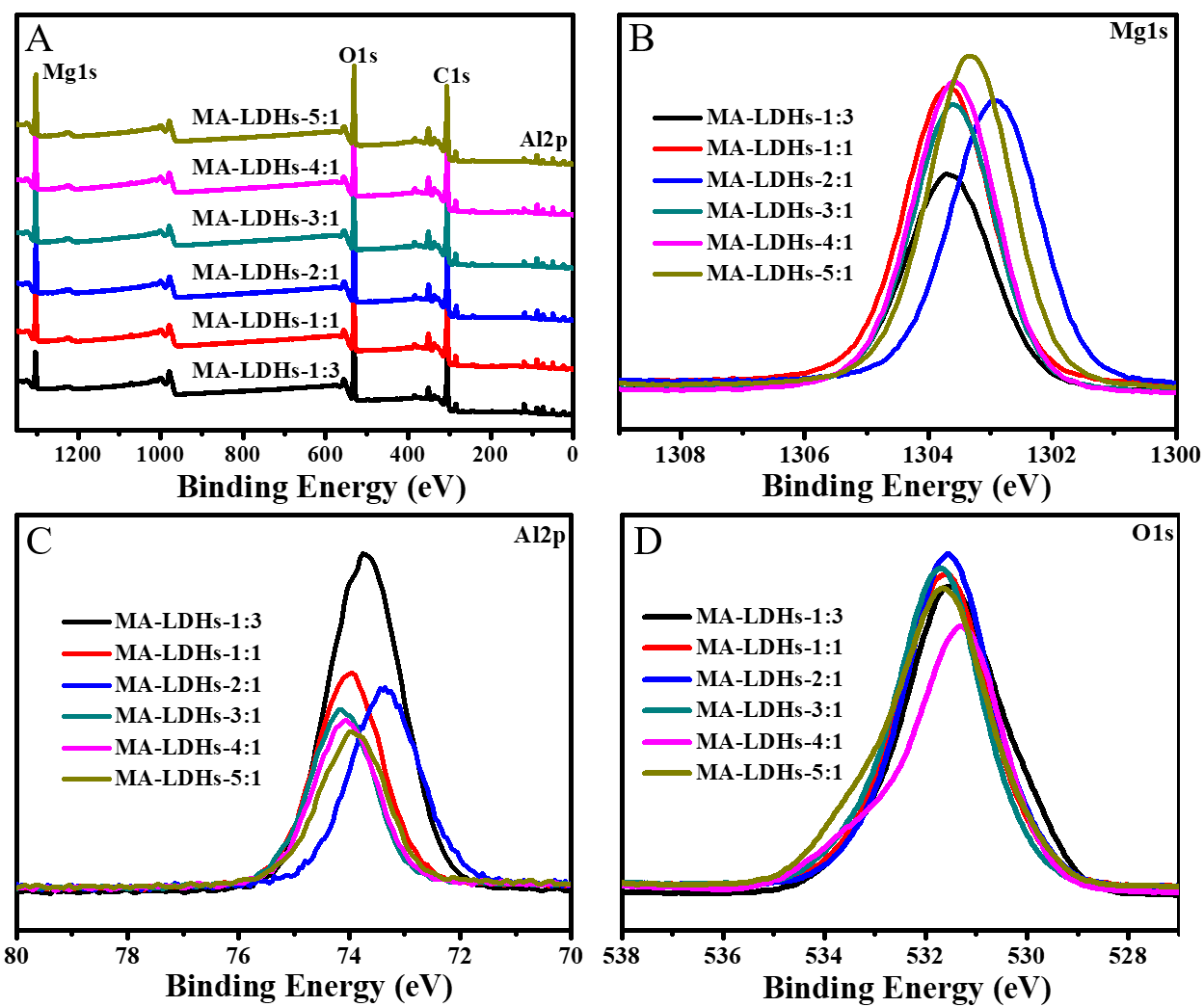
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Feed | Catalyst | WHSV (mL g-1·h-1) | Temp. (°C) | Conv. (%) | Refs. |
| 110 mg/m3 COS/N2 | MA-LDHs-3:1 | 12000 | 110 | 100 | This work |
| 110 mg/m3 COS/N2 | MA-LDHs-3:1 | 6000 | 90 | 100 | This work |
| 200 ppm COS/N2 | Co/CeO2 | 6000 | 150 | 69.8 | S15 |
| 110 mg/m3 COS/N2 | HKUST-1-E25 | 4500 | 110 | 79.4 | S16 |
| 110 mg/m3 COS/N2 | A-N-OMC-900 | 6000 | 130 | 100 | S17 |
| COS/N2= 1/99 | Zn-Al HTLCs | 10 000 | 50 | 55.1 | S18 |
| 500 ppm COS/N2 | Fe-Cu-KOH/WSB | 10 000 | 70 | 54.2 | S19 |

**Table S3** Comparison of different catalysts used for H2S selective oxidation.

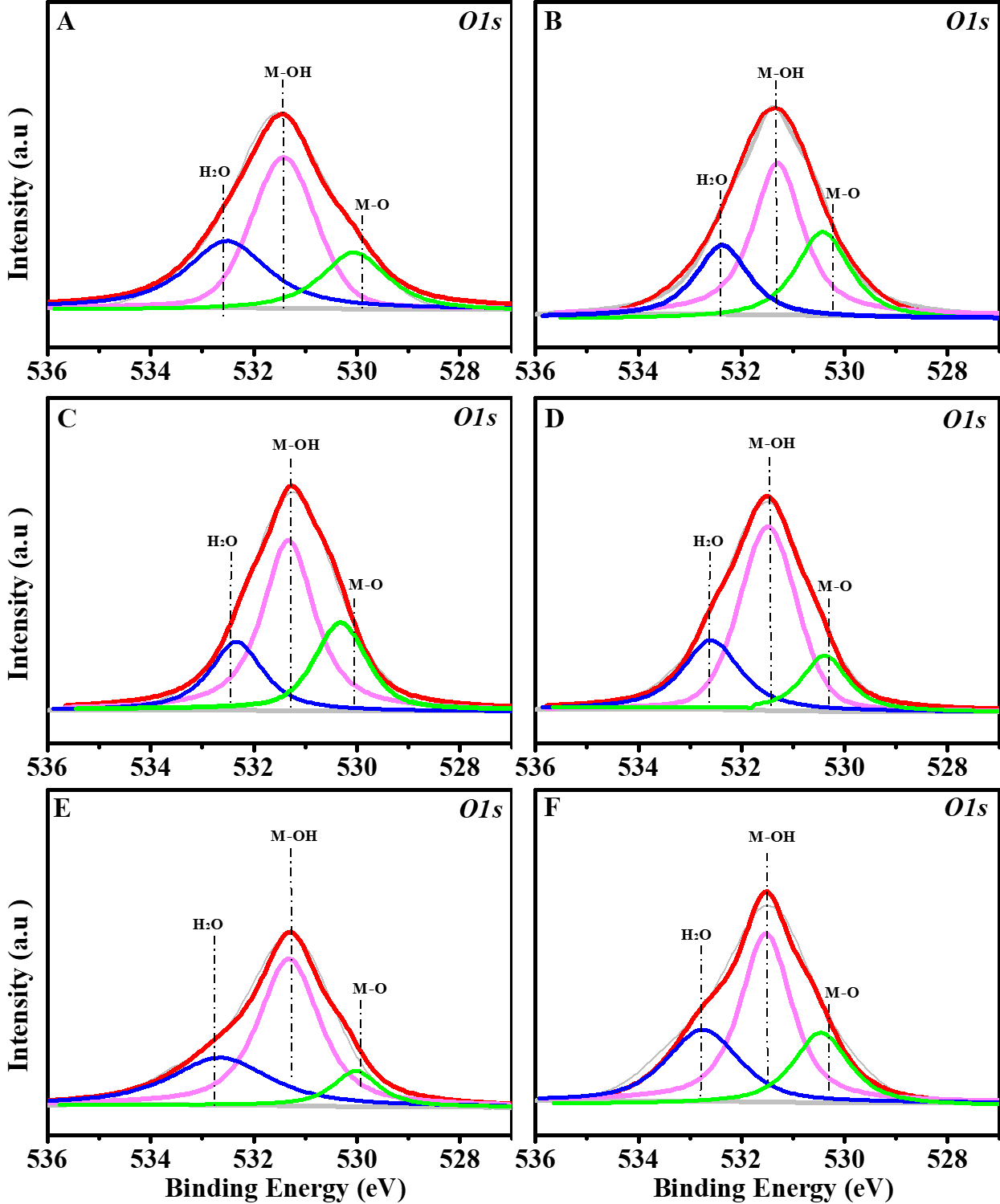
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Feed | Catalyst | WHSV (mL g-1·h-1) | Temp. (°C) | Conv. (%) | Sel. (%) | Refs. |
| H2S/O2/N2= 0.5/0.25/99.25 | MA-LDHs-3:1 | 12 000 | 120 | 100 | 100 | This work |
| H2S/O2/N2= 0.5/0.25/99.25 | MA-LDHs-2:1 | 12 000 | 120 | 100 | 100 | This work |
| H2S/O2/N2= 0.5/0.25/99.25 | MgAlCeO-0.8 | 5000 | 120 | 91 | 100 | S5 |
| H2S/O2/N2= 0.5/0.25/99.25 | Mg2Al0.6Fe0.4O | 24 000 | 120 | 85.3 | 100 | S6 |
| H2S/O2/N2= 0.5/0.25/99.25 | Mg2Al0.3V0.7O | 24 000 | 120 | 62.5 | 100 | S7 |
| H2S/O2/N2= 0.05/0.025/99.925 | 8%V2O5/CeO2 | 18 000 | 200 | 90 | 98.2 | S8 |
| H2S/O2/He= 5/2.5/92.5 | CeO2-TiO2 | 10 000 | 250 | 100 | 98.9 | S9 |
| H2S/O2/N2= 0.5/0.25/99.25 | NH2-MIL-53(Fe) | 3000 | 160 | 94 | 90 | S10 |
| H2S/O2/N2= 0.5/0.25/99.25 | Fe2O3/SiC | 3000 | 250 | 100 | 81 | S11 |
| H2S/O2/N2= 0.5/0.25/99.25 | Al2O3 | 10 500 | 180 | 94.6 | 10 | S12 |
| H2S/O2/He= 1/1.1/97.8 | Fe/Al2O3 | / | 250 | 69 | 89 | S13 |
| H2S/O2/He= 1/15/86 | Ni-Cu modified NFC | 3100 | 200 | 78 | 25 | S14 |



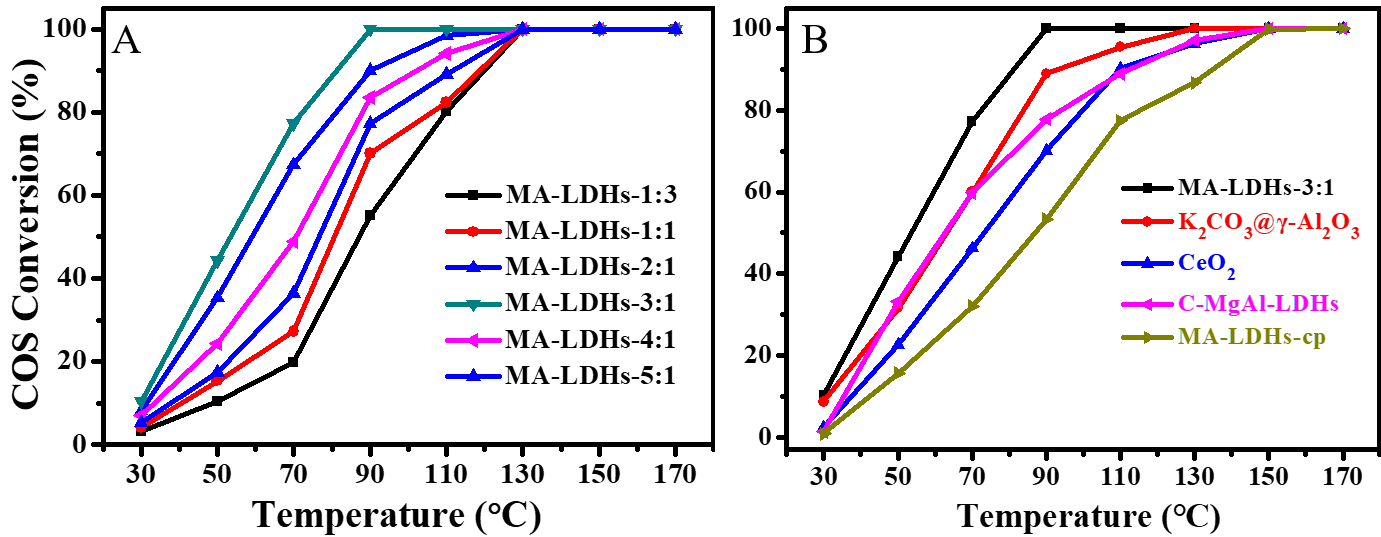
**Figure S1** FT-IR spectra of MA-LDHs-x samples.

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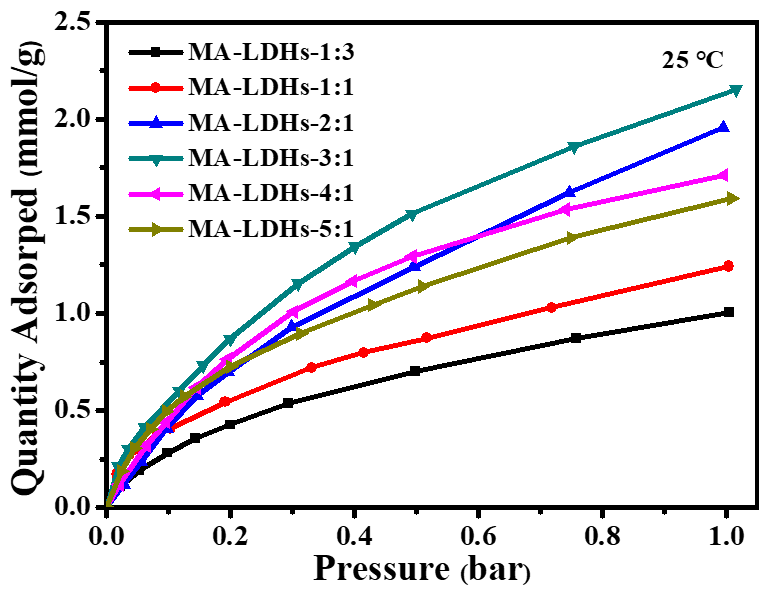
**Figure S2** XPS spectra of MA-LDHs-x samples. A: Survey; B: Mg1s; C: Al2p and D: O1s.



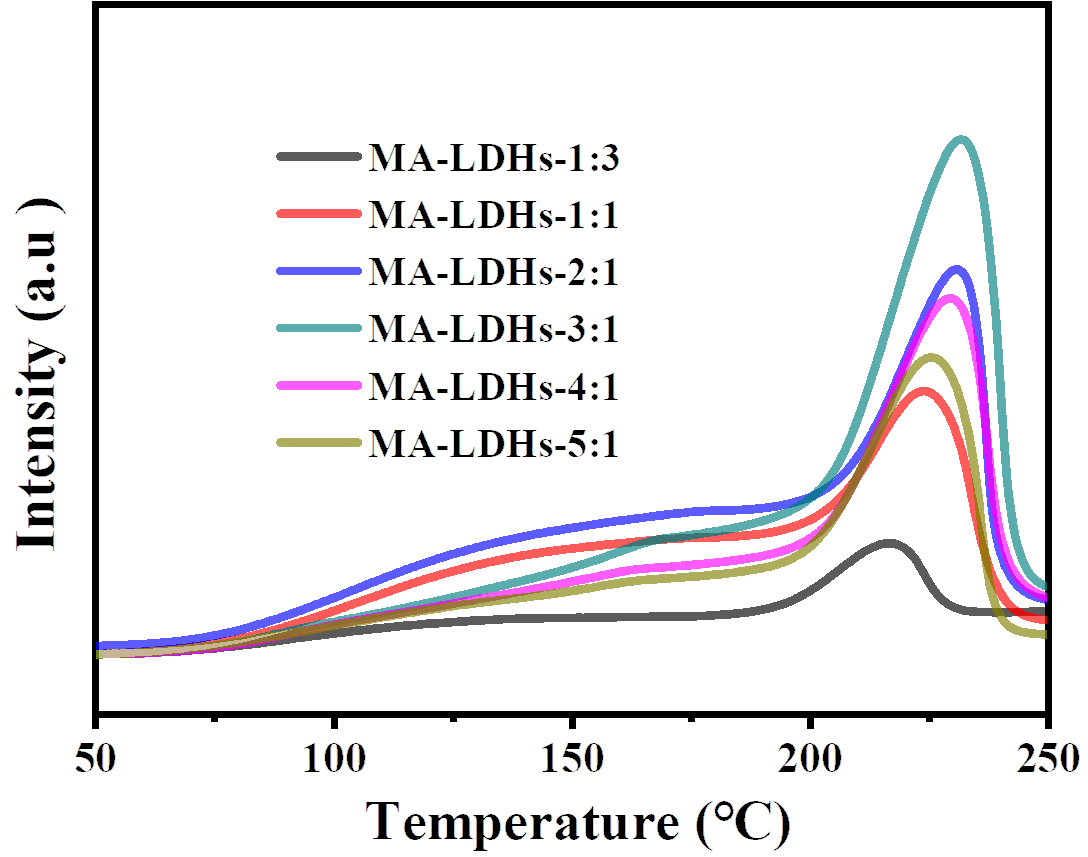
**Figure S3** O1s spectra of MA-LDHs-x samples, A: MA-LDHs-1:3; B: MA-LDHs-1:1; C: MA-LDHs-2:1; D: MA-LDHs-3:1; E: MA-LDHs-4:1; F: MA-LDHs-5:1.



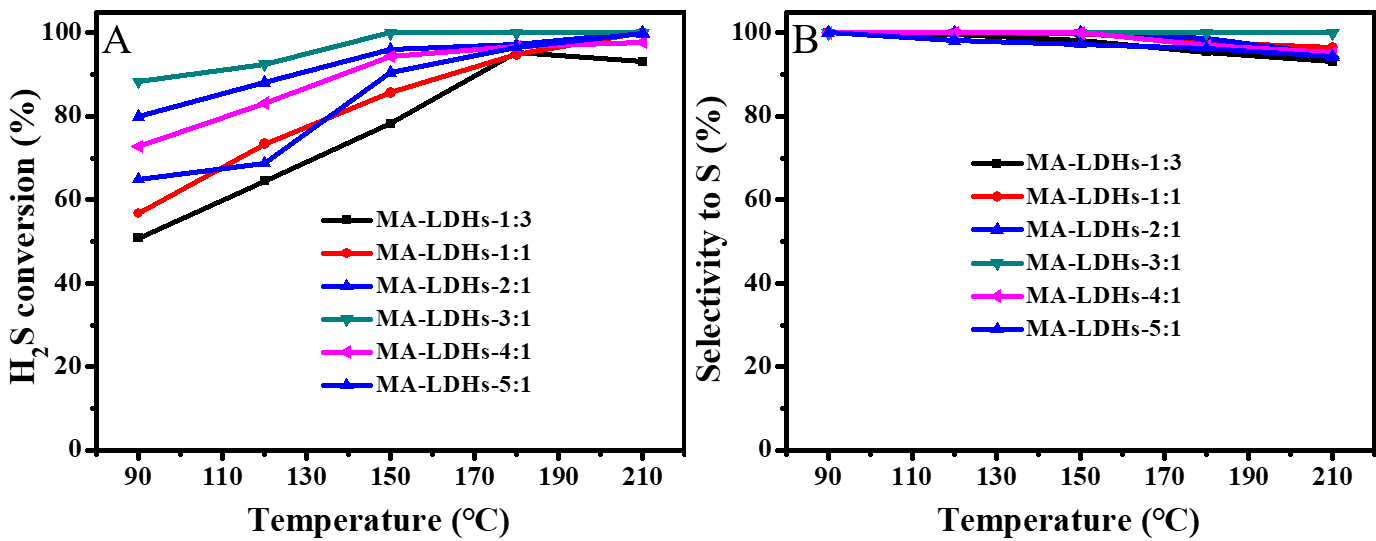
**Figure S4** Effect of temperature on COS hydrolysis over (A) MA-LDHs-x and (B) various kinds of reference catalysts. Reaction condition: 200 mg of catalyst, feed gas 110 mg/m3 COS/N2, WHSV (6000 mL g-1·h-1), water temperature 40 °C.



**Figure S5** H2S adsorption isotherm of MA-LDHs-x samples



**Figure S6** H2S-TPD-MS experiments conducted over MA-LDHs-x samples.



**Figure S7** Effect of reaction temperature on (A) H2S conversion and (B) H2S selectivity of MA-LDHs-x samples in H2S selective oxidation. Reaction condition: catalyst (100 mg), H2S/O2/N2=0.5/0.25/99.25 (wt%), WHSV (12 000 mL g-1·h-1).

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