Electronic Supplementary Information for

Synthesis of highly dispersed metal sulfide catalysts via low temperature sulfidation in a dielectric barrier discharge plasma

Lu Zhao,[a] Yao Wang,*[a] Zhili Sun,[a] Anjie Wang,[a] Xiang Li,[a] Chunshan Song[a,b] and Yongkang Hu[a]

[a] Key Laboratory of Industrial Ecology and Environmental Engineering (MOE), PSU-DUT Joint Center for Energy Research, School of Chemical Engineering, Dalian University of Technology, Dalian 116024. P.R. China
E-mails: wangyao@dlut.edu.cn; Fax: +86-411-8498-6121; Tel: (+86) 411 8498 6121

[b] EMS Energy Institute, Department of Energy and Mineral Engineering, The Pennsylvania State University, C211 CUL, University Park, PA 16802-2323, USA

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1 Temperature distribution across the catalyst bed under actual reaction conditions in H_2S plasma sulfidation.

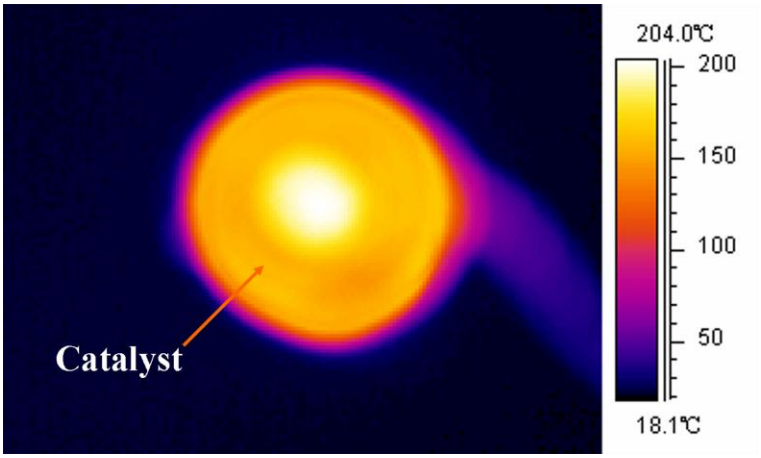

Fig. S1 Temperature distribution across the catalyst bed under actual reaction conditions in H_2S plasma sulfidation.

2 Synthesis of other supported metal sulfide catalysts by the plasma sulfidation method.

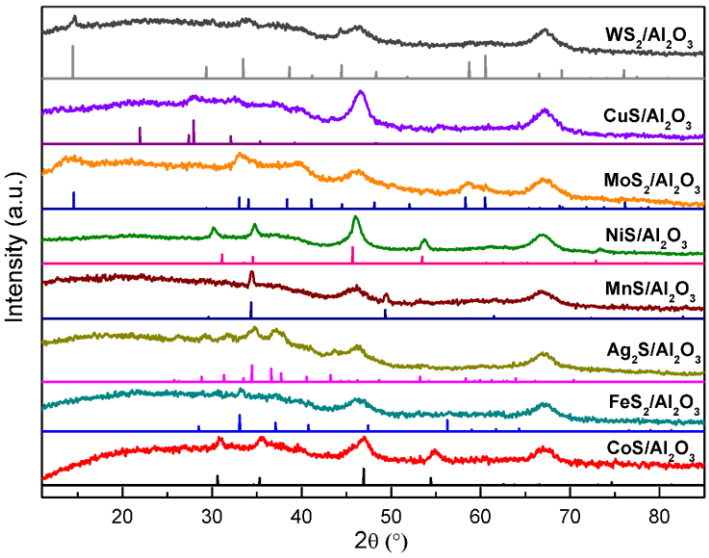

Fig. S2 XRD patterns of supported CoS, FeS_2, Ag_2S, MnS, NiS, MoS_2 CuS and WS_2 synthesized from their salt precursors by the DBD plasma sulfidation method.

$Co(NO_3)_2$, $Fe(NO_3)_3$, $AgNO_3$, $Mn(NO_3)_2$, $Ni(NO_3)_2$, $(NH_4)_6Mo_7O_{24}$, $Cu(NO_3)_2$ and $(NH_4)_6W_{12}O_{39}$ were used in the preparation of CoS, FeS_2, Ag_2S, MnS, NiS, MoS_2, CuS and WS_2. A loading level of 10 wt% oxide precursor was chosen for each catalyst. Metal salts were dissolved in 3 mL de-ionized water. The resulting solution was mixed with 3 g γ-Al_2O_3 particles, and were kept at room temperature for 8 h. Then the mixture was dried in an oven at 120 ^oC for 12 h. Two gram of the precursor was charged into the DBD reactor. 10% H_2S/Ar was allowed to pass through the bed at 80 mL/min. After 10 minutes, the plasma-assisted sample was prepared. The total input of the AC power was about 25 W in steady state. The voltage of the high-voltage electrode was kept at around 10 kV and the discharge frequency at 10 kHz. Fig. S2 shows that supported CoS, FeS_2, Ag_2S, MnS, NiS, MoS_2, CuS and WS_2 catalysts were obtained from their salt precursors by DBD plasma sulfidation. Furthermore, taking into consideration that metal salts are easily homogeneously mixed, it should even be possible to synthesize ternary and quaternary metal sulfides like CdZnS, CuZnS, CoMoS and others.

3 XP S 2p spectra of CdS/Al_2O_3 and ZnS/Al_2O_3 synthesized by different methods.

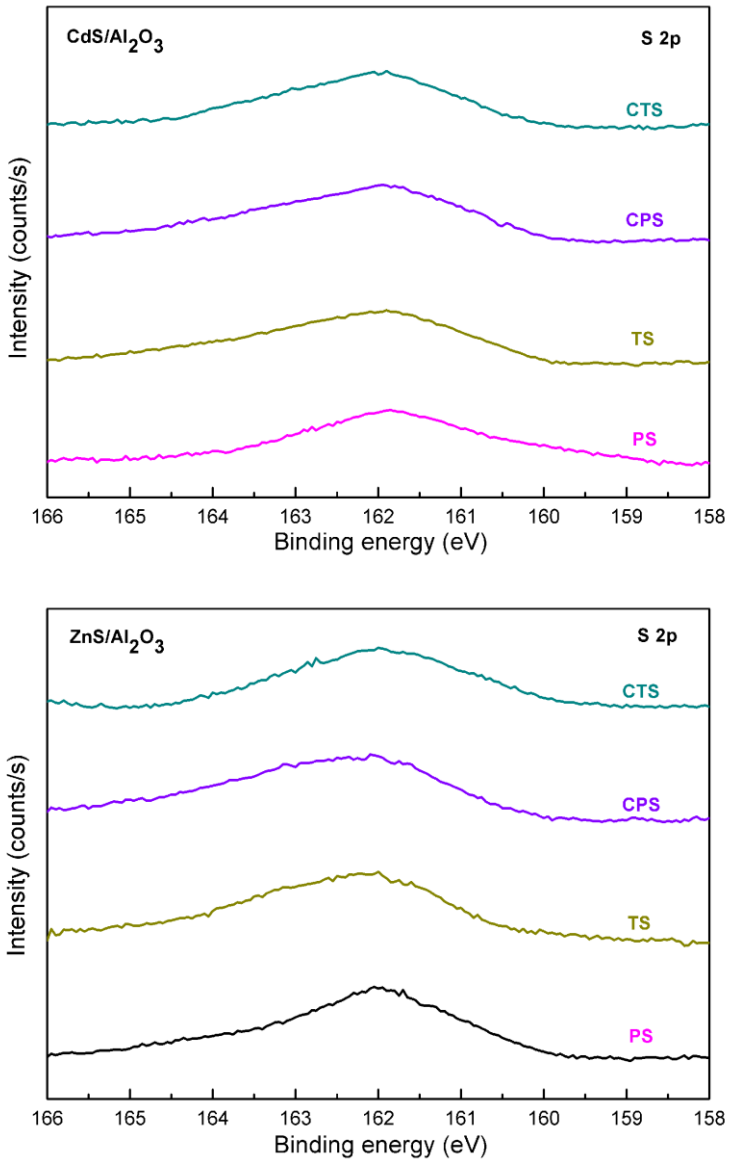

Fig. S3 XP S 2p spectra of CdS/Al_2O_3 and ZnS/Al_2O_3 synthesized by different methods.

4 Elemental composition of CdS/Al_2O_3 and ZnS/Al_2O_3 synthesized by different methods.

Table S1 Elemental composition of CdS/Al_2O_3 and ZnS/Al_2O_3 synthesized by different methods

Catalyst	Total elemental composition (%)					Surface elemental composition (%)				
	Cd	Zn	S	Al	O	Cd	Zn	S	Al	O
CdS/Al_2O_3 (CTS)	1.35	—	1.35	27.46	69.84	1.39	—	1.34	25.66	71.61
CdS/Al_2O_3 (TS)	1.33	—	1.34	29.52	67.81	1.41	—	1.43	26.47	70.69
CdS/Al_2O_3 (CPS)	1.38	—	1.39	30.21	67.02	1.53	—	1.68	26.28	70.51
CdS/Al_2O_3 (PS)	1.41	—	1.43	30.49	66.67	1.43	—	1.59	27.50	69.48
ZnS/Al_2O_3 (CTS)	—	2.35	2.42	29.00	66.23	—	2.08	2.02	28.56	67.34
ZnS/Al_2O_3 (TS)	—	2.09	2.00	29.79	66.12	—	1.86	1.97	27.95	68.22
ZnS/Al_2O_3 (CPS)	—	2.16	2.23	29.47	66.14	—	1.98	2.12	26.64	69.26
ZnS/Al_2O_3 (PS)	—	2.47	2.61	31.44	63.48	—	2.14	2.35	27.10	68.41

5 Catalytic stability of plasma-sulfided catalysts in H_2S decomposition.

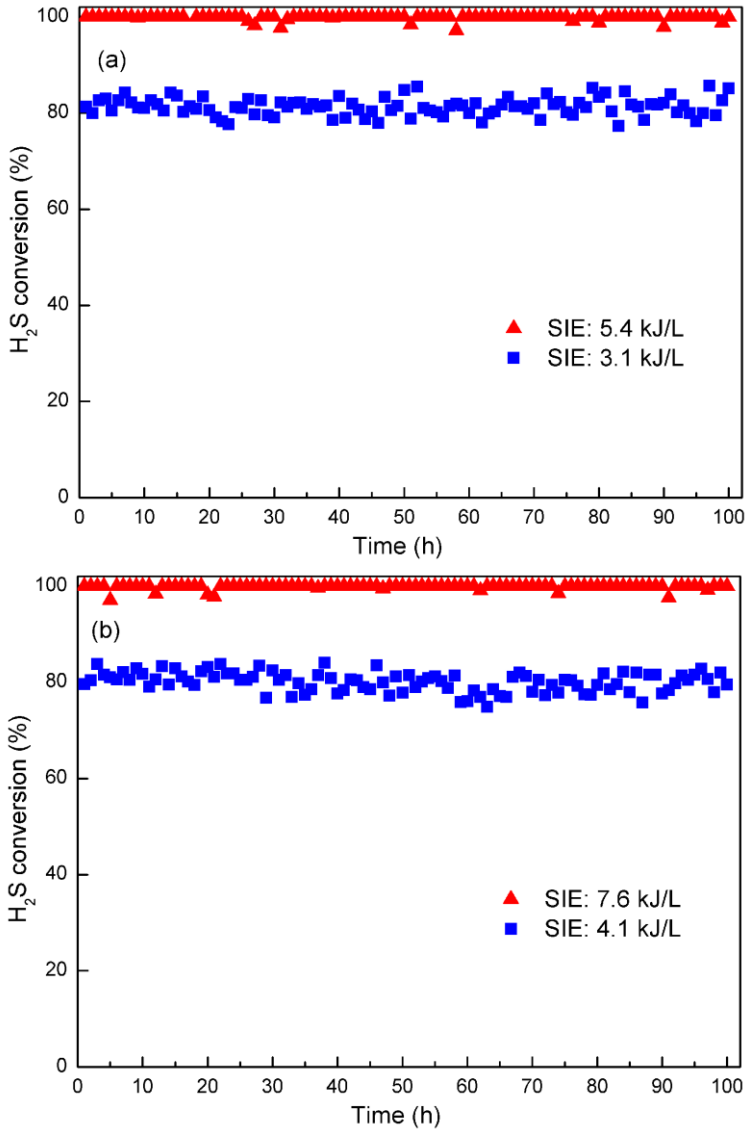

Fig. S4 Variation of H_2S conversion with time in the plasma-induced decomposition over (a) CdS/Al_2O_3 (PS) and (b) ZnS/Al_2O_3 (PS) at different SIE. Reaction conditions: feed: 20% H_2S in Ar; GHSV: 120 h^{-1}; catalyst bed volume: 15.0 mL.

The H_2S conversion variations in H_2S decomposition over CdS/Al_2O_3 (PS) and ZnS/Al_2O_3 (PS) in the 100 h long-term tests are presented in Fig. S4. The stabilities of both catalysts at full conversion and at around 80% conversion were investigated. Evidently, the catalysts prepared with the plasma method were stable.