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蒸氨法制备铜硅催化剂的二甲醚水蒸气重整制氢性能

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Catalytic Performance for Hydrogen Production through Steam Reforming of Dimethyl Ether over Silica Supported Copper Catalysts Synthesized by Ammonia Evaporation Method

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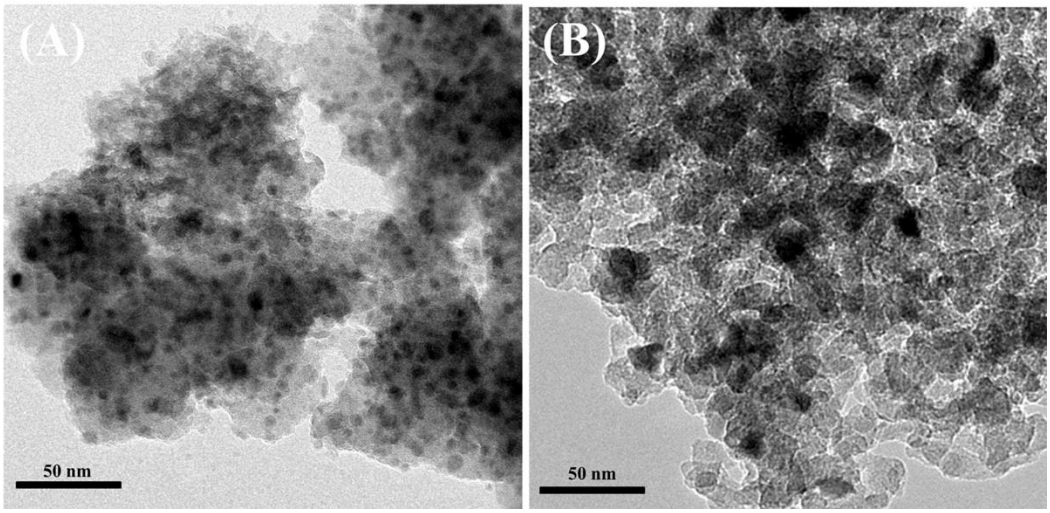

图 S1 反应后催化剂的 TEM 图

Fig.S1 TEM images of the spent catalysts

(A) 30Cu/SiO_2-AE and (B) 30Cu/SiO_2-IM.

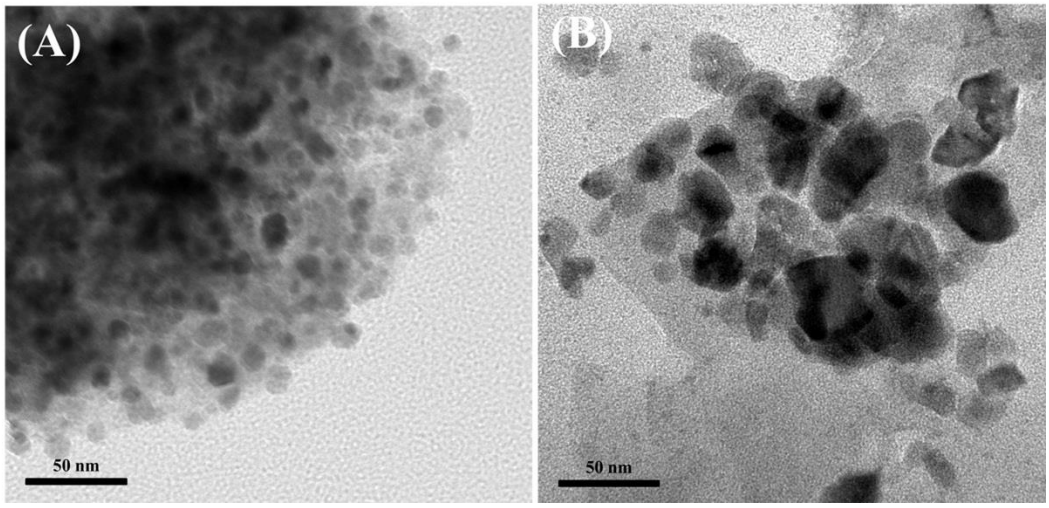

图 S2 失活后催化剂的 TEM 图

Fig.S2 TEM images of the degraded catalysts

(A) 30Cu/SiO_2-AE and (B) 30Cu/SiO_2-IM.

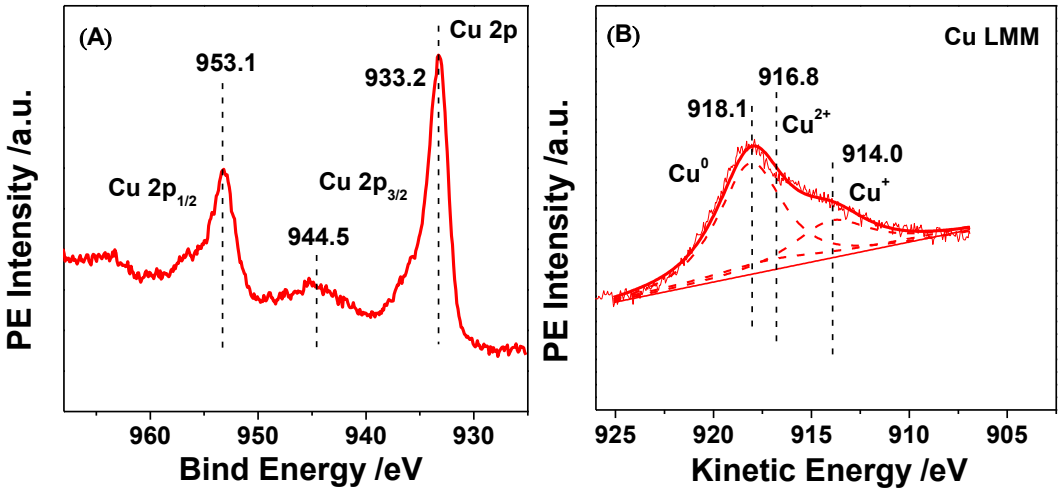

图 S3　失活后催化剂的 Cu 2*p* XPS 谱图（A）和 Cu LMM 谱图（B）

Fig.S3　Cu 2*p* XPS spectra (A) and Cu LMM spectra (B) of the degraded 30Cu/SiO_2-AE catalyst.

表 S1　*x*Cu/SiO_2 催化剂和其他 Cu 基催化剂的催化活性

Table S1　Catalytic performance of the *x*Cu/SiO_2 catalysts and the referenced catalysts.

Catalysts	Conv.(%)[a]	Y.(%)[a]	Sel.(%)[a]			
	DME	H_2	CO	CO_2	CH_4	CH_3OH
15Cu/SiO_2-AE	83.4	80.3	12.9	87.2	0.3	ND[b]
20Cu/SiO_2-AE	89.1	84.7	15.3	84.9	0.2	ND
25Cu/SiO_2-AE	93.5	89.8	11.9	88.0	0.5	ND
30Cu/SiO_2-AE	95.7	91.9	12.2	88.1	0.1	ND
35Cu/SiO_2-AE	90.6	86.6	13.3	86.9	0.6	ND
30Cu/SiO_2-IM	15.2	14.3	17.2	83.2	0.8	0.07
$CuZnAl_{0.8}Zr_{0.2}O$ [14]	~80	<80	>11	<91	<1	-
Cu/ZnO/Al_2O_3 [11]	~84	<75	>14	<88	<1	-
$CuZnAlCe_{0.1}O$ [11]	~93	<86	>11	<90	<1	-
$CuFe_2O_4$ Spinel [22]	~96	-	>10	<90	<0.5	-
2Cu/1Ni/5Al_2O_3 [15]	~100	<70	-	-	>5.0	-

[a] Reaction conditions (including the referenced catalysts): Gas hourly space velocity (GHSV) – 12000 mL^{-1} g_{cat}^{-1} (15000 $mL \cdot h^{-1}$ g_{cat}^{-1} for the $CuZnAl_{0.8}Zr_{0.2}O$, 6000 h^{-1} for the $CuFe_2O_4$ Spinel, 3240 $mL \cdot h^{-1}$ g_{cat}^{-1} for the 2Cu/1Ni/5Al_2O_3), S/C =2.5/1 (2.0/1 for the $CuZnAl_{0.8}Zr_{0.2}O$, 1.5/1 for the $CuFe_2O_4$ Spinel, 2.0/1 for the 2Cu/1Ni/5Al_2O_3), T = 380 °C

[b] Not detected (ND)