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Rhenium oxide modified $H_3PW_{12}O_{40}/TiO_2$ catalysts for selective oxidation of dimethyl ether to dimethoxy dimethyl ether

Qingde Zhang,[a] Yisheng Tan,[a]* Guangbo Liu, [a b] Junfeng Zhang, [a] Yizhuo Han[a]*

Catalyst characterization

XRD

XRD patterns were measured on a Bruker Advanced X-Ray Solutions/D8-Advance using Cu Ka radiation. The anode was operated at 40kV and 40mA. The 2Theta angles were scanned from 5° to 70°.

FT-IR spectra

FT-IR spectra were measured on a Bruker Tensor 27 instrument with MCT detector.

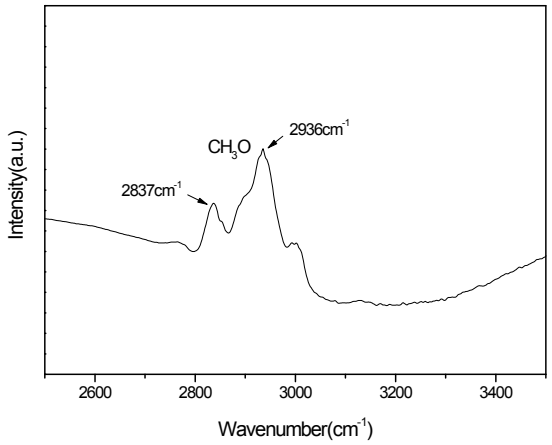

Fig. SI-1. DMM desorption over 5%Re-20%PW_{12}/TiO_2 at 513K

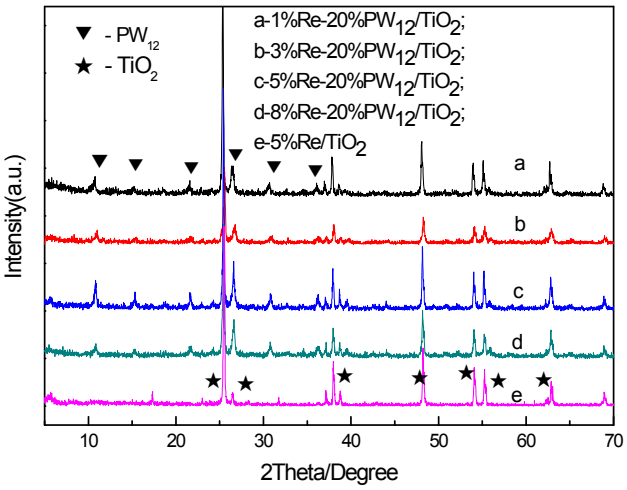

Fig. SI-2. XRD patterns of the catalysts.

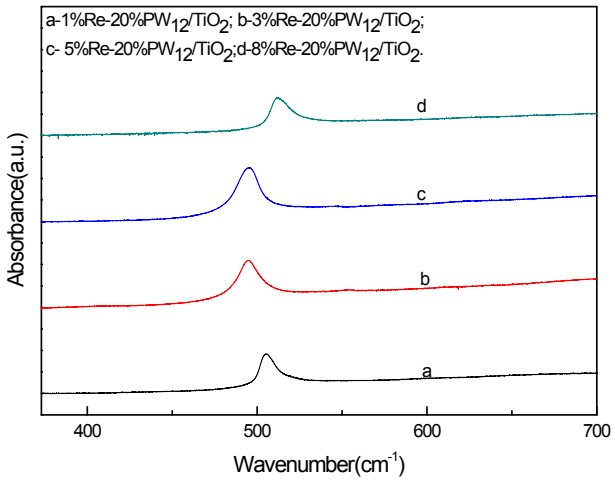

Fig. SI-3. H_2-TPR profiles of Re-PW_{12}/TiO_2 with different Re loading

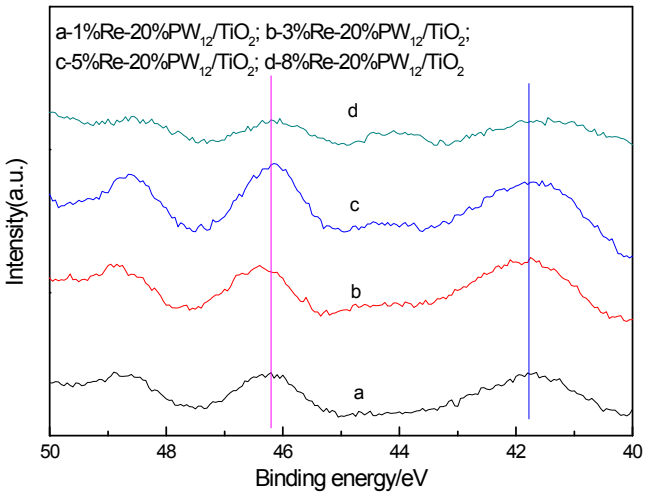

Fig. SI-4. Re 4f XPS spectra for the Re-PW_{12}/TiO_2 catalysts

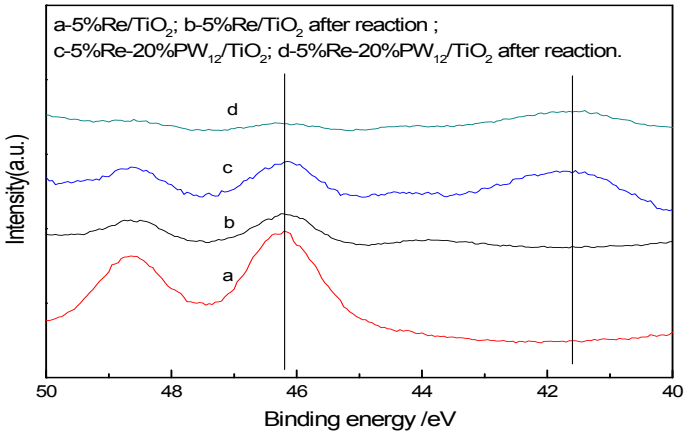

Fig. SI-5. XPS of the catalysts.

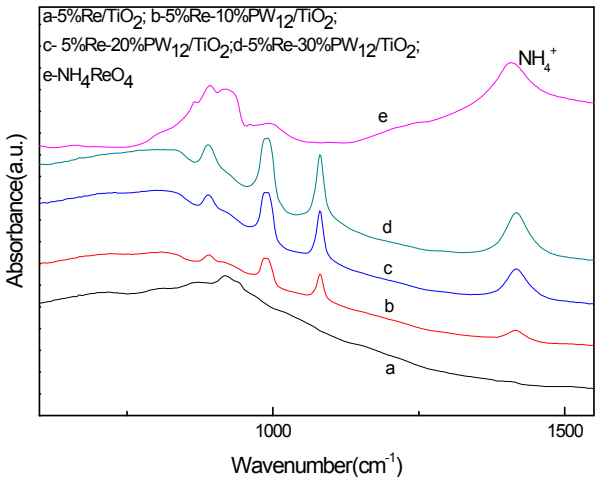

Fig. SI-6. FT-IR spectra of Re-PW_{12}/TiO_2 catalyst

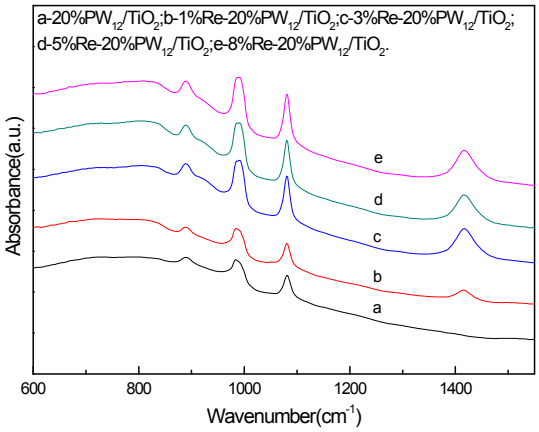

Fig. SI-7. FT-IR spectra of Re-PW_{12}/TiO_2 catalyst

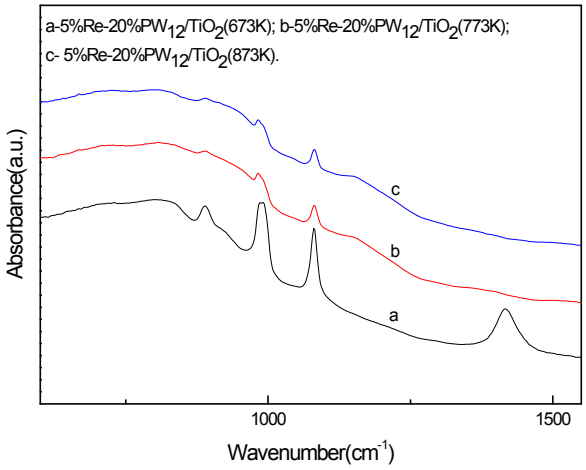

Fig. SI-8. FT-IR spectra of Re-PW_{12}/TiO_2 calcined at different temperatures

Table SI-1 Effects of different feedstocks on the formation of DMM_2 over 5%Re-20%PW_{12}/TiO_2

	DME	DMM	Selectivity(C-mol%)								
Reactant	conversion(%)	conversion(%)	DMM	DME	DMM_2	CH_3OH	HCHO	MF	CO	CH_4	CO_2
DME+Ar [a]	2.3	-	0.5	-	0	22.5	68.1	0.1	0.8	3.4	4.6
DMM+Ar [b]	-	31.2	-	56.8	4.0	5.3	3.3	30.6	0	0	0
DME+DMM+Ar [c]	7.9	33.6	-	-	4.4	19.4	43.2	27.4	1.4	1.2	3.0

Reaction conditions: atmospheric pressure, 513K, cat.: 1 ml, 3600h^{-1}. [a] nAr:nDME =1.3:1.2, [b] nAr:nDMM=1.3:1, [C] nAr:nDME:nDMM=1.3:1.2:1.

Table SI-2 Results of H_2-TPR integration

	Reduction peak
Catalyst	Area
5%Re-10%PW_{12}/TiO_2	231180
5%Re-20%PW_{12}/TiO_2	473705
5%Re-30%PW_{12}/TiO_2	320506

Table SI-3 Results of Re^{4+} and Re^{7+} for 5%Re-20%PW_{12}/TiO_2

	Re^{4+}	Re^{7+}	Ratio
Catalyst	Area (%)	Area (%)	S_{Re4+}/S_{Re7+}
The fresh	59.4	40.6	1.5
The used	64.4	35.6	1.8