Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Pt-based nanoparticles decorated by phosphorus-doped $CuWO_4$ to enhance methanol oxidation activity

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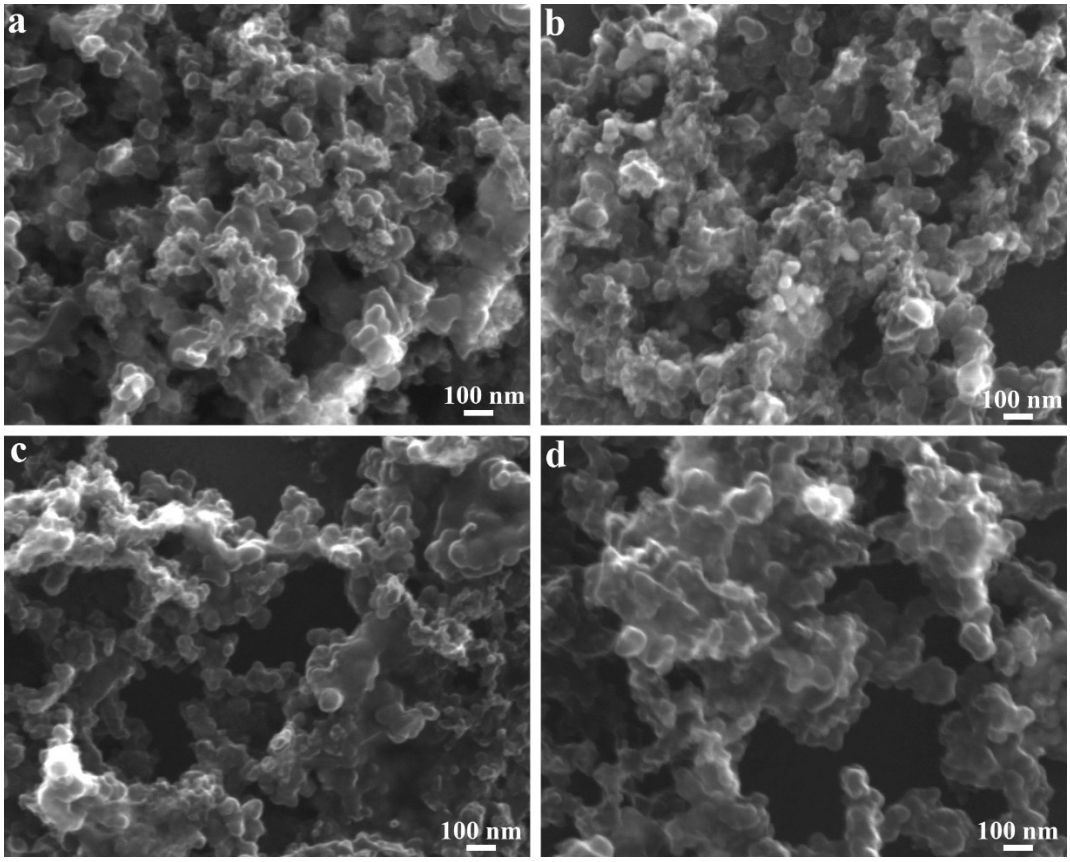

Figure. S1. SEM patterns of $CuWO_4 \cdot 2H_2O$/C (a), C/P-$CuWO_4$ (b) and $Cu(OH)_2$/C(c), C/P-CuO (d)， respectively.

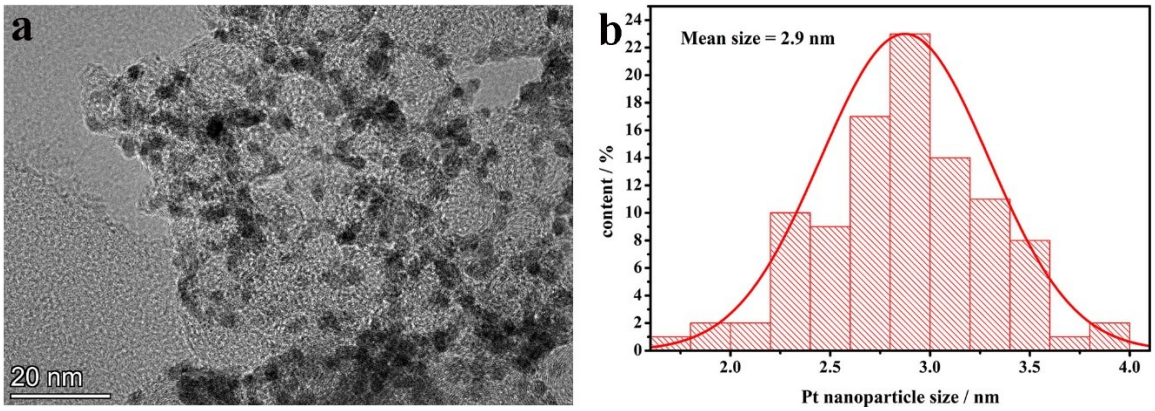

Figure. S2. TEM patterns and mean size of Pt NPs of Pt/C-$CuWO_4$

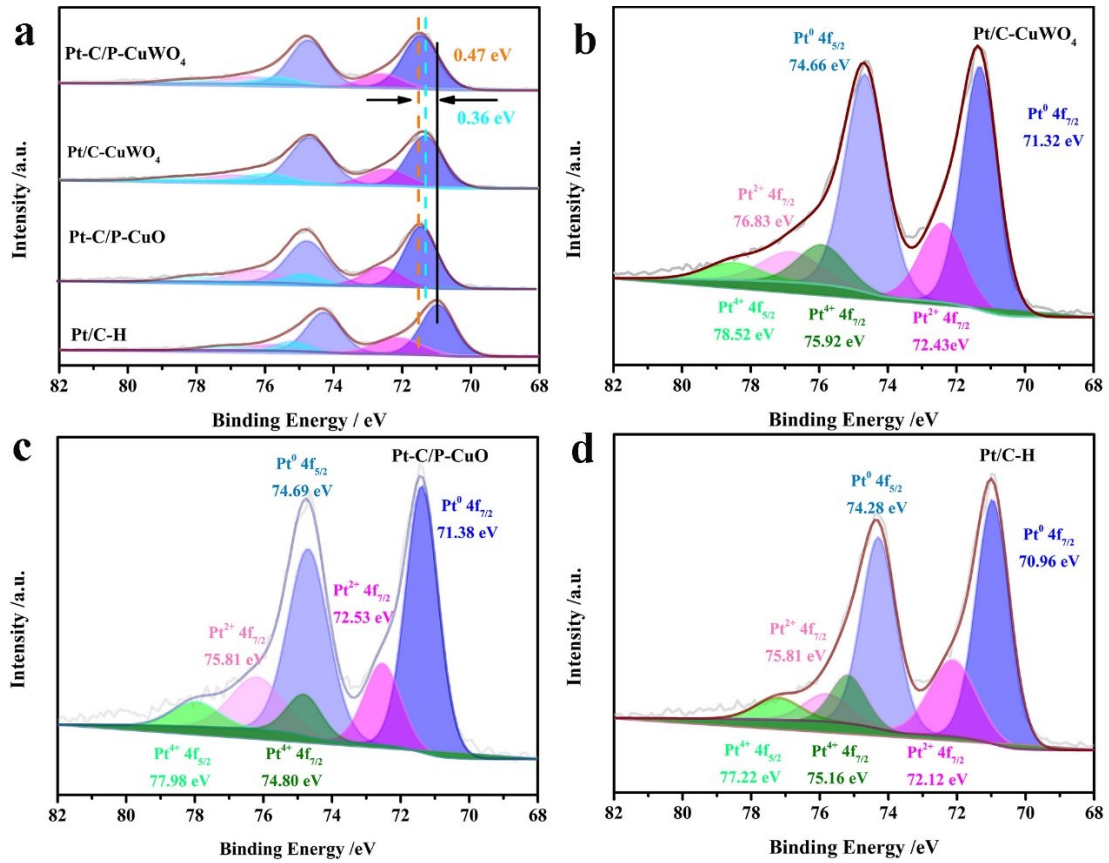

Figure. S3 XPS spectraXPS survey spectra of catalysts (a) and Pt 4f spectra of Pt-C/P-$CuWO_4$(b), Pt/C-$CuWO_4$ (c), Pt-C/P-CuO(d), Pt-C/P-WO_3(e) and Pt/C-H (f), respectively.

Table S1: The fitting results and surface components of the Pt 4f spectra for catalysts.

samples	Pt^0		Pt^{2+}		Pt^{4+}	
	Binding Energy (eV)	Relative ratio %	Binding Energy (eV)	Relative ratio %	Binding Energy (eV)	Relative ratio %
Pt-C/P-$CuWO_4$	71.43 74.81	70.30	72.67 76.51	18.5	75.72 78.26	11.2
Pt/C-$CuWO_4$	71.32 74.66	68.06	72.43 76.83	20.6	75.92 78.52	11.34
Pt-C/P-CuO	71.38 74.69	66.08	72.53 76.20	23.25	74.80 77.98	10.68
Pt/C-H	70.96 74.28	66.24	72.12 75.16	21.39	75.81 77.22	12.37

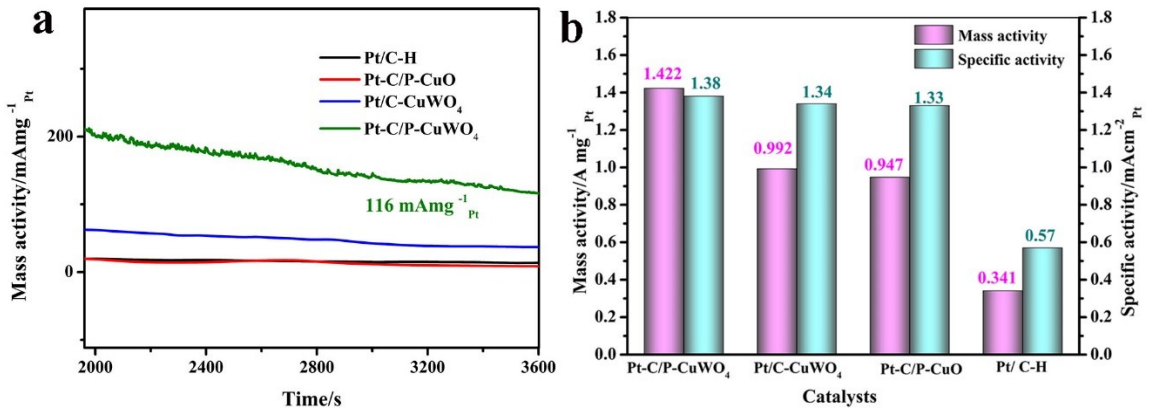

Figure. S4 Chronoamperometric curves of Pt-C/P@$CuWO_4$/C, Pt/C-$CuWO_4$, Pt-C/P-CuO and Pt/C-H catalysts in 0.5 M H_2SO_4 solution at a scan rate of 50 mV s^{-1} (a)，the mass activity and specific activity (b).

Table S2: Electro-chemic values in 0.5 M H_2SO_4 solution of four samples toward electrochemical active surface area (ECSA)

samples	**ECSA** ($m^2 \cdot g^{-1}_{Pt}$)	**Specific activity** （$mA \cdot cm^{-2}_{Pt}$）	**Mass activity** （$mA \cdot mg^{-1}_{Pt}$）
Pt-C/P-$CuWO_4$	103.28	1.38	1422
Pt/C-$CuWO_4$	73.87	1.34	992
Pt-C/P-CuO	71.13	1.33	947
Pt/C-H	59.70	0.57	341

Table S3: summarized this work and other reported accomplishments in methanol oxidation reaction.

samples	ECSA ($m^2 \cdot g^{-1}_{Pt}$)	Mass activity （$mA \cdot mg^{-1}_{Pt}$）	Conditions	References
Pt-C/P-$CuWO_4$	103.28	1422	0.5 M H_2SO_4 +1.0 M CH_3OH	This work
Pt-WO_2/WO_3	-	694	0.5 M H_2SO_4 +1.0 M CH_3OH	[1]
Pt/Fe_3O_4-SNG	162.06	1129	0.5 M H_2SO_4 +0.5 M CH_3OH	[2]
Pt/NiCoPx@NCNT-NG	54.2	857	0.5 M H_2SO_4 +0.5 M CH_3OH	[3]
PtPdNiP TOMNs	57.1	1040	0.5 M H_2SO_4 +1.0 M H_3OH	[4]
Pt/TiO_2/NDC	36.3	527	0.5 M $HClO_4$ +1.0 M CH_3OH	[5]

References

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