Supporting information

Hydrochlorination of Acetylene catalyzed by activated carbon supported chlorotriphenylphosphine gold complex

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Table S1 Mass loss of fresh and used $AuCl_3$/AC and $AuPPh_3Cl$/AC catalysts under different temperature ranges.

Temperature/ °C	< 150	150-470
Mass loss of $AuCl_3$/AC-fresh catalyst, (%)	0.5	2.8
Mass loss of $AuCl_3$/AC-used catalyst, (%)	0.5	5.4
Mass loss of $AuPPh_3Cl$/AC-fresh catalyst, (%)	0.5	3.3
Mass loss of $AuPPh_3Cl$/AC-used catalyst, (%)	0.5	5.1

The calculation of coking deposition

Take $AuCl_3$/AC catalyst for instance:

The fresh $AuCl_3$/AC catalyst shows a mass loss of 2.8% in the 150-470 °C range, indicating a mass loss of 2.8 g per 100 g of $AuCl_3$/AC sample; while for the used $AuCl_3$/AC catalyst, the mass loss in the same range is 5.4%, indicating a mass loss of 5.4 g per 100 g of ($AuCl_3$/AC catalyst + coke). Assuming that the coke deposition amount on the used $AuCl_3$/AC catalyst equals X, the following equations should be satisfied, 100/2.8=(100-X)/Y, and Y+X=5.4.

Then, the value of X is solved to be 2.7.

Thereby, the coking deposition amount on the surface of the used $AuCl_3$/AC catalyst is 2.7%.

Table S2 Size of Au particles in Au-based catalysts, determined by XRD [a].

Catalyst	Au particles size (nm)	
	Fresh	Used
$AuCl_3$/AC	<4 [b]	19.9 ± 3
$AuPPh_3Cl$/AC	<4 [b]	<4 [b]

[a] Error estimated from XRD peak broadening of 0.06 º at the Au (111) reflection at 38.14 º (2θ).

[b] It was impossible to assign any error band below 4 nm, as this size is below the XRD method.

Table S3 Desorption amount of C_2H_2, HCl and C_2H_3Cl on the fresh catalysts

Catalyst	Desorption area of HCl	Desorption area of C_2H_2	Desorption area of C_2H_3Cl
$AuCl_3$/AC	2422	1968	2473
$AuPPh_3Cl$/AC	3568	1273	1308

Table S4 The catalytic performance of some potential Au-based catalysts recently reported in the literatures.

	Composition of catalyst	Reaction conditions	Initial catalytic activity	During the time period (h)	Deactivation rate (% h^{-1})
$AuPPh_3Cl/AC$ [this work]	0.521 wt% Au, TPP	T=170°C,GHSV(C_2H_2)=360 h^{-1}, V_{HCl}/V_{C2H2}=1.1	X_A=96.3%, S_{VCM}=99.9%	200	0.055
$Na_3Au(S_2O_3)_2/C$ [1]	0.15 wt% Au	T=180°C,GHSV(C_2H_2)=227 h^{-1} V_{HCl}/V_{C2H2}=1.2	X_A = 90%, S_{VCM} > 99.0%	150	0.067
Catal. ACS [2]	0.25 wt% Au, 1.62 wt% Cu, 2.46 wt% KSCN	T=180°C,GHSV(C_2H_2)=360 h^{-1} $V_{HCl}/V_{C2H2}/V_{N2}$=1.1/1/0.083	X_A= 98%, S_{VCM} > 99.0%	10	0.048
$[AuCl_2(phen)]Cl/AC$ [3]	0.49 wt% Au, [$AuCl_2$(phen)]Cl 1,10-phenanthroline	T=180°C, GHSV(C_2H_2)=280 h^{-1} V_{HCl}/V_{C2H2} = 1.2	X_A=96%, S_{VCM} > 99.5%	40	0.075
Au/Cu/TCCA [4]	0.2 wt% Au, TCCA, $CuCl_2$ n(Au)/n(Cu)/n(TCCA)=1/5/20	T=180°C, GHSV(C_2H_2)=90 h^{-1} V_{HCl}/V_{C2H2} = 1.2	X_A=98%	12	0.023
$AuCl_3$-thiourea/AC [5]	0.4 wt% Au, 0.75% thiourea	T=170 °C, GHSV(C_2H_2)=870h^{-1} V_{HCl}/V_{C2H2}=1.15	X_A=78.67%,S_{VCM} >99.9%	20	0.409
Au1La3/SAC [6]	1 wt% Au, $LaCl_3$ n(La)/n(Au)=3	T=150°C, GHSV(C_2H_2)=360 h^{-1} V_{HCl}/V_{C2H2}=1.15	X_A=100%, S_{VCM}=99.9%	48	0.208
Au1Co(III)3/SAC [7]	1 wt% Au, $Co(NH_3)_6Cl_3$ n(Co)/n(Au)=3	T=150°C, GHSV(C_2H_2)=360 h^{-1} V_{HCl}/V_{C2H2}=1.15	X_A=99.9%, S_{VCM}=99.9%	48	0.165
Au1Ba(II)1/AC [8]	1 wt% Au, $BaCl_2$ n(Ba)/n(Au)=1	T=200°C, GHSV(C_2H_2)=360 h^{-1} V_{HCl}/V_{C2H2}=1.15	X_A=97.2%, S_{VCM}>99.0%	86	0.057
1Au1In4Cs/AC [9]	1.0 wt% Au, CsCl, $InCl_3$ 4.0 wt% Cs, 1 wt% In	T=180°C,GHSV(C_2H_2)=1480h^{-1} V_{HCl}/V_{C2H2}=1.2	X_A=92.8%, S_{VCM}>99.9%	50	0.130
Au1Co3Cu1/SAC [10]	0.919 wt% Au, $Co(NH_3)_6Cl_3$, $CuCl_2$ n(Co)/n(Cu)/n(Au)=3/1/1	T=150°C, GHSV(C_2H_2)=720 h^{-1} V_{HCl}/V_{C2H2}=1.15	X_A=99.0%, S_{VCM}=99.9%	270	0.189
Au/20%P-SAC-700 [11]	1.16 wt% Au, TPP (carrier	T=170°C, GHSV(C_2H_2)=360 h^{-1}	X_A=99.9%, S_{VCM}=100%	45	0.064

	-dopant), 20 wt% TPP	V_{HCl}/V_{C2H2}=1.1			
$AuCl_3$/5PPy-MWCNT[12]	1.27wt%Au,Polypyrrole	T=180°C, GHSV(C_2H_2)=100 h^{-1}	X_A=93%	100	0.103
	(carrier-dopant)	V_{HCl}/V_{C2H2}=1.15			

[a] X_A represents the initial conversion of acetylene and S_{VCM} represents the initial selectivity to VCM of the catalyst.

[b] Deactivation rate was defined as (the initial maximum C_2H_2 conversion – the final C_2H_2 conversion)/(deactivation period, h) [13]

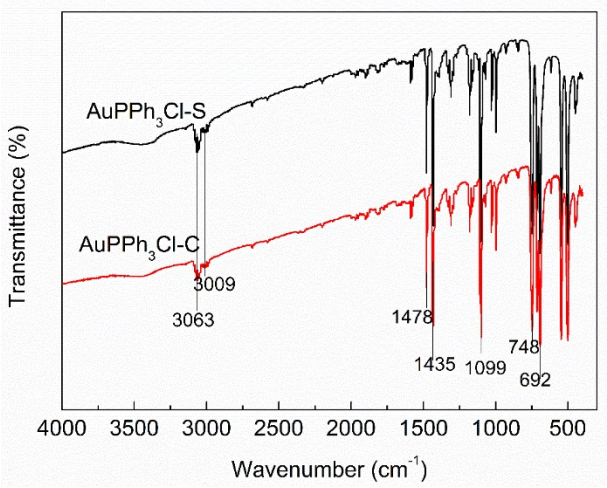

Fig. S1 FT-IR spectra of the synthesized $AuPPh_3Cl$-S and commercial $AuPPh_3Cl$ ($AuPPh_3Cl$-C)

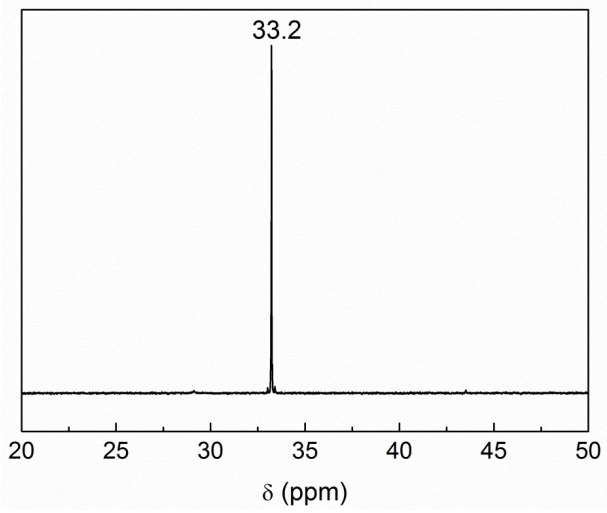

Fig. S2 The ^{31}P NMR spectra of the synthesized $AuPPh_3Cl$ complex

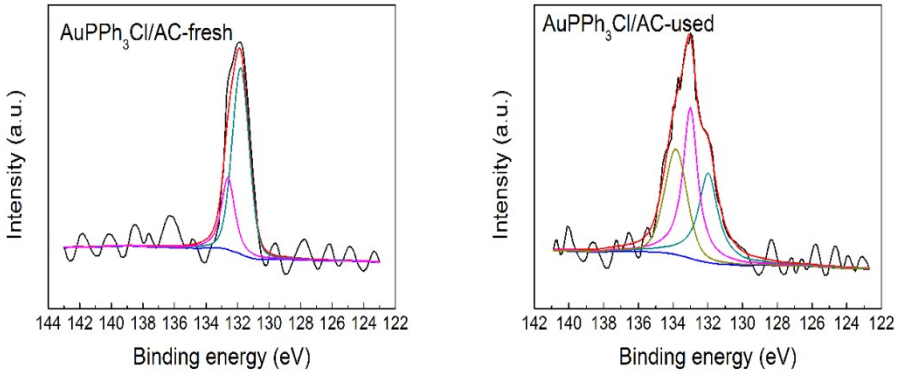

Fig. S3 P 2p XPS spectra of the fresh and used $AuPPh_3Cl$/AC catalyst.

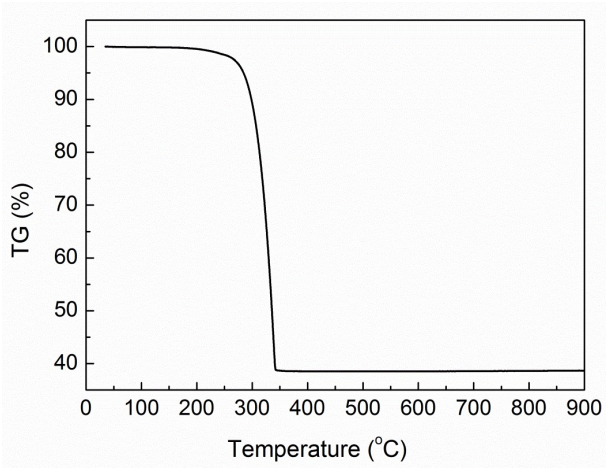

Fig. S4 TGA curve of $AuPPh_3Cl$-S crystal at a heating rate of 10 °C min^{-1} under nitrogen atmosphere.

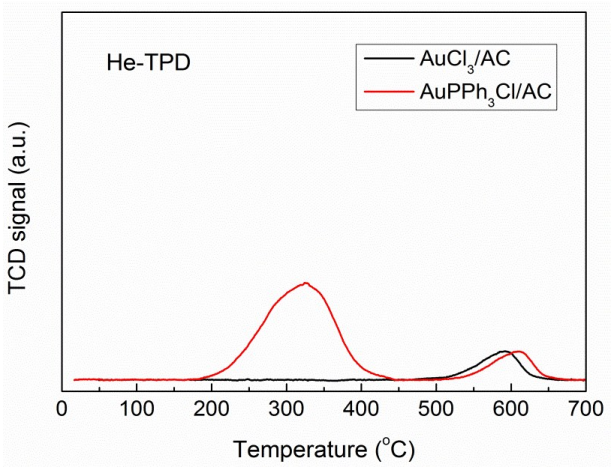

Fig. S5 TPD profile of the fresh $AuCl_3$/AC and $AuPPh_3Cl$/AC catalysts in pure helium atmosphere.

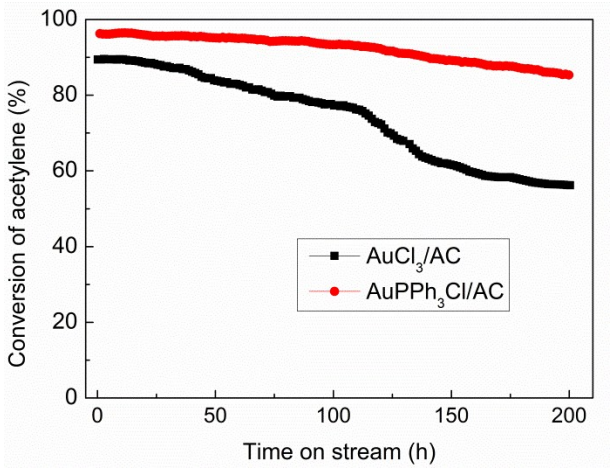

Fig. S6 Comparison of stability of $AuCl_3$/AC and $AuPPh_3Cl$/AC. Reaction condition: temperature (T) = 170 °C, GHSV(C_2H_2) = 360 h^{-1} and V_{HCl}:V_{C2H2} = 1.1.

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