Supplementary Material

Ru supported on activated carbon and coated with polydopamine layer for effective acetylene hydrochlorination

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Table S2 EXAFS fitting parameters at the edge for various samples.

Fig. S1 The (a) C_2H_2 conversion and (b) selectivity to VCM of different catalysts. Reaction condition: T=180 °C, GHSV(C_2H_2) =180 h^{-1}, and V(HCl)/V(C_2H_2) =1.15.

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1 **Table S1** The relative content and binding energy of Ru species in the unreacted and reacted Ru-based catalysts.

Catalyst	Binding energy (eV)，（Area%）					
	Ru^{n+} (n>4)	Ru^{4+}	Ru^{3+}	Ru^{z+}(1< z <3)	Ru^{0}	Ru^{m+}(m ≥3)
Unreacted Ru/AC	467.6 (14.2)	465.0 (17.2)	463.1 (35.0)	/	461.3 (33.6)	66.4
Reacted Ru/AC	467.3 (8.9)	464.9 (26.2)	463.1 (29.9)	/	461.5 (35.0)	65.0
Unreacted Ru/AC@PDA-*100*	467.3 (15.4)	465.2 (23.0)	463.9 (30.3)	462.0 (31.3)	/	68.7
Reacted Ru/AC@PDA-*100*	467.7 (11.1)	465.2 (18.3)	463.2 (35.7)	/	461.2 (34.9)	65.1
Unreacted Ru/AC@PDA-*500*	467.5 (19.7)	465.4 (22.8)	463.5 (29.6)	461.6 (27.9)	/	72.1
Reacted Ru/AC@PDA-*500*	467.8 (18.1)	465.1 (16.1)	463.1 (33.1)	/	461.4 (32.7)	67.3
Unreacted Ru/AC@PDA-*800*	467.6 (26.9)	465.7 (22.0)	463.6 (25.2)	461.6 (25.9)	/	74.1
Reacted Ru/AC@PDA-*800*	468.0 (12.2)	465.4 (14.6)	463.4 (33.6)	/	461.4 (39.6)	60.4

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Table S2 EXAFS fitting parameters at the edge for various samples.

Sample	shell	CN	R(Å)	σ^2	ΔE_0	R factor
Ru foil	Ru-Ru	12	2.67±0.01	0.0037	2.2±0.7	0.0085
RuO_2	Ru-O	7.8±1.0	1.98±0.01	0.0029	2.5±1.9	0.0197
$RuCl_3$	Ru-Cl	5.3±0.5	2.35±0.02	0.0036	0.2±2.1	0.0227
	Ru-O/N	1.7±0.4	1.81±0.02	0.0021		
Ru/AC	Ru-Cl	4.2±0.3	2.36±0.01	0.0016	-2.0±1.8	0.0139
	Ru-Ru	4.1±0.6	2.60±0.02	0.0071		
	Ru-O/N	5.4±0.1	2.07±0.01	0.0041		
Ru/AC@PDA-*100*					4.3±0.7	0.0030
	Ru-Ru	1.5±0.1	2.71±0.01	0.0048		
	Ru-O/N	5.9±0.4	2.07±0.01	0.0064		
Ru/AC@PDA-*500*					2.8±1.8	0.0137
	Ru-Ru	1.1±0.2	2.70±0.01	0.0037		
Ru/AC@PDA-*800*	Ru-O/N	6.5±0.3	2.04±0.01	0.0040	3.6±1.2	0.0037

[a]*N*: coordination numbers; [b]*R*: bond distance; [c]σ^2: Debye-Waller factors; [d] ΔE_0: the inner potential correction. *R* factor: goodness of fit. S_0^2 was set to 0.71, according to the experimental EXAFS fit of Ru foil reference by fixing CN as the known crystallographic value; δ: percentage.

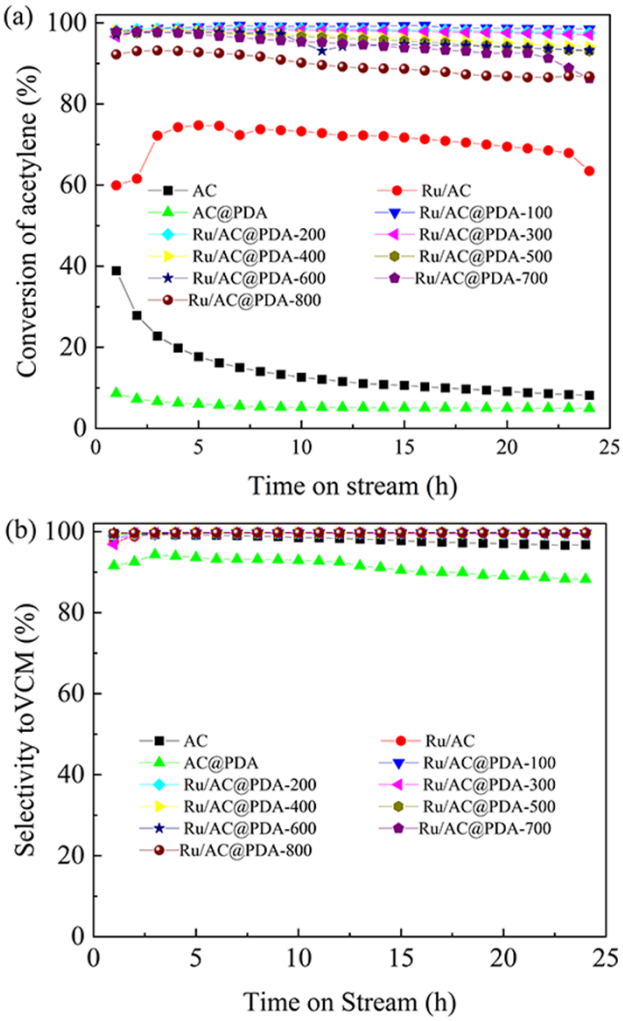
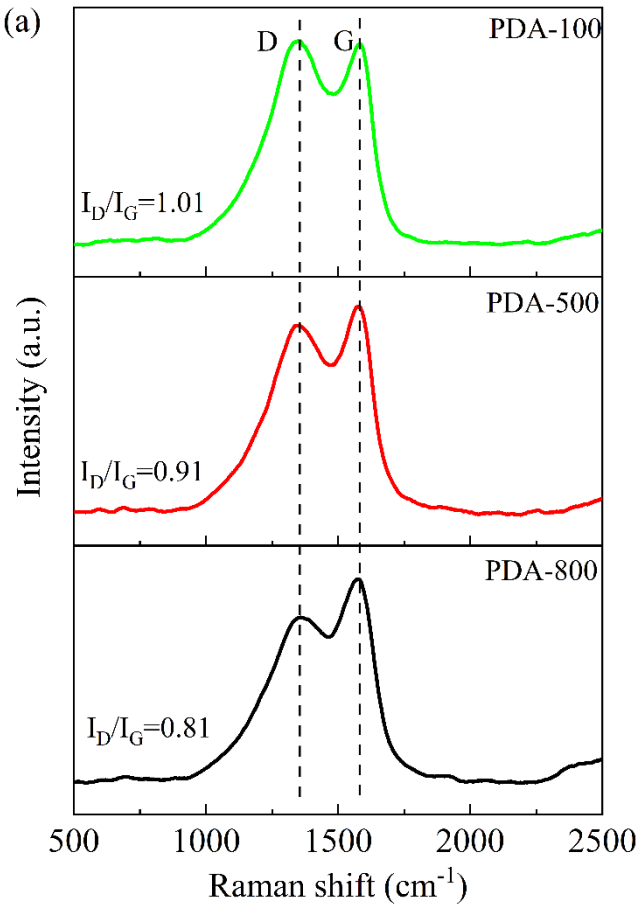


Fig. S1 The (a) C_2H_2 conversion and (b) selectivity to VCM of different catalysts. Reaction condition: T=180 °C, GHSV(C_2H_2) =180 h^{-1}, and V(HCl)/V(C_2H_2) =1.15.



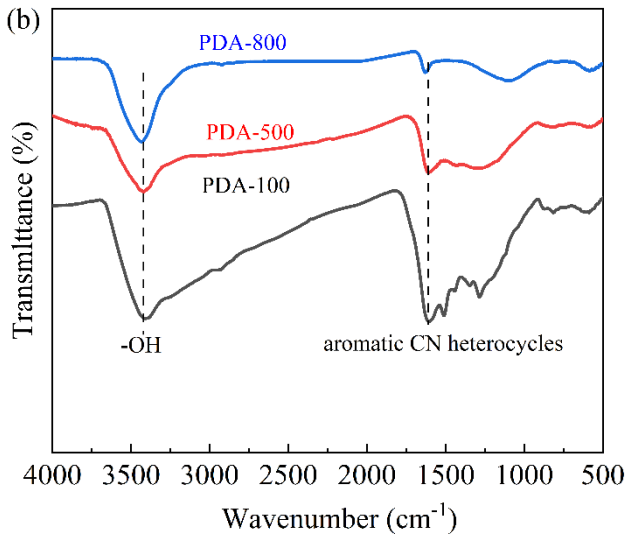


Fig. S2 (a) Raman spectra and (b) FT-IR spectra of PDA-*T* materials.

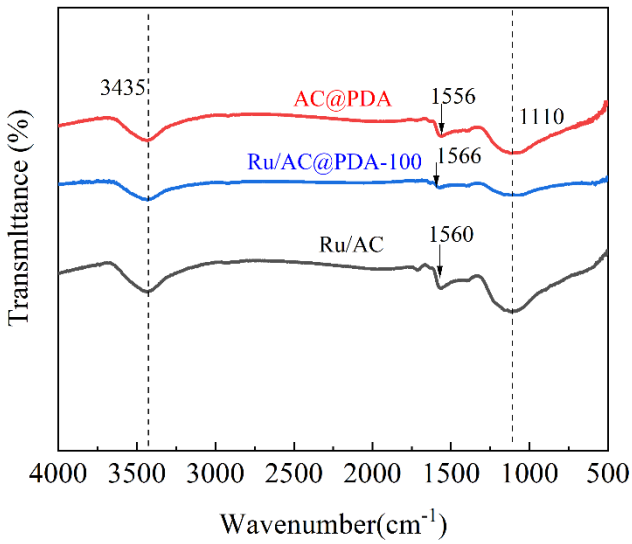


Fig. S3 FT-IR spectra of unreacted catalysts.

The characteristic peaks are centered at 3435 cm^{-1}: the -OH stretching vibration (e.g., those in phenol, carboxyl and chemisorbed water) [1], 1110 cm^{-1}: C-O stretching vibrations (e.g., ethers and phenols) [2, 3], and 1560 cm^{-1}: aromatic CN heterocycles [4, 5].

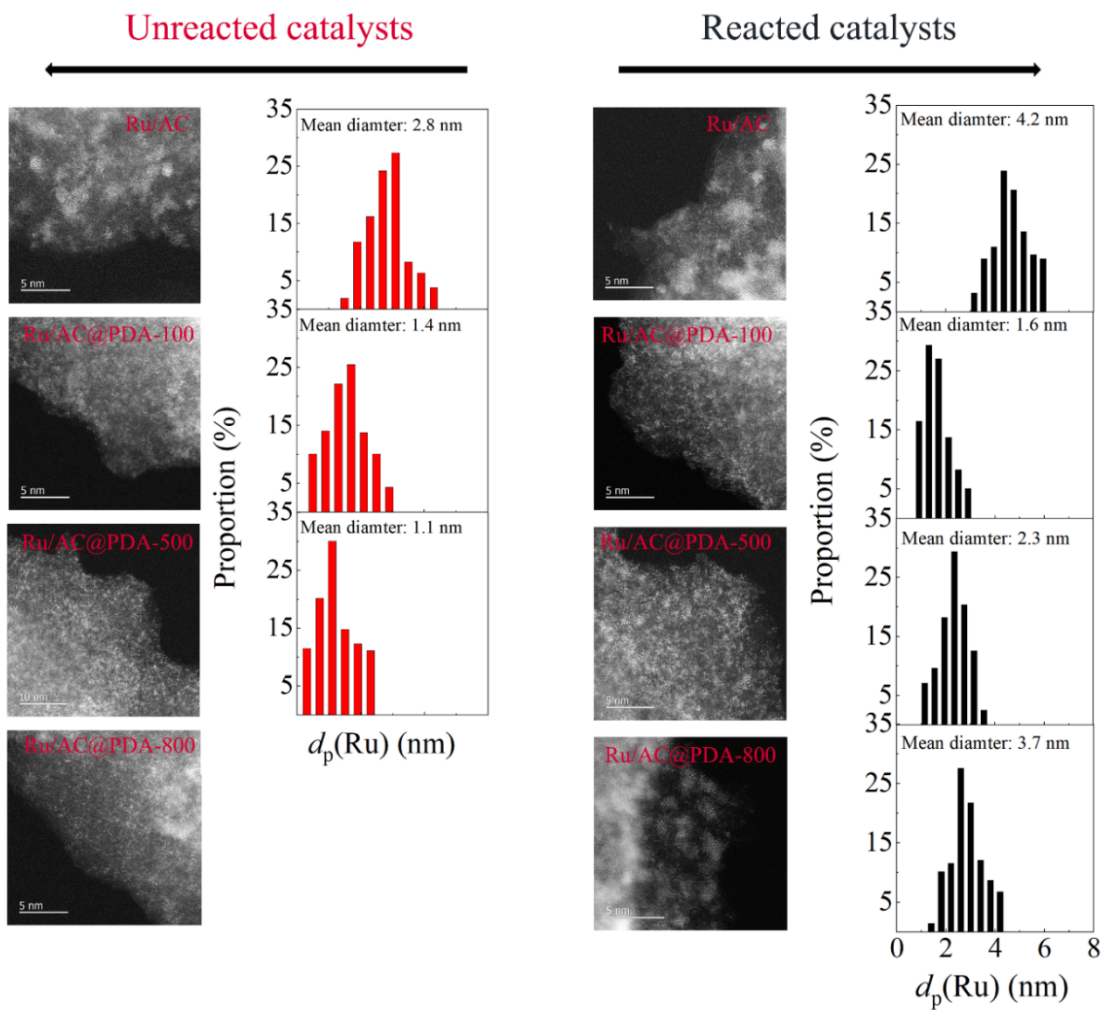
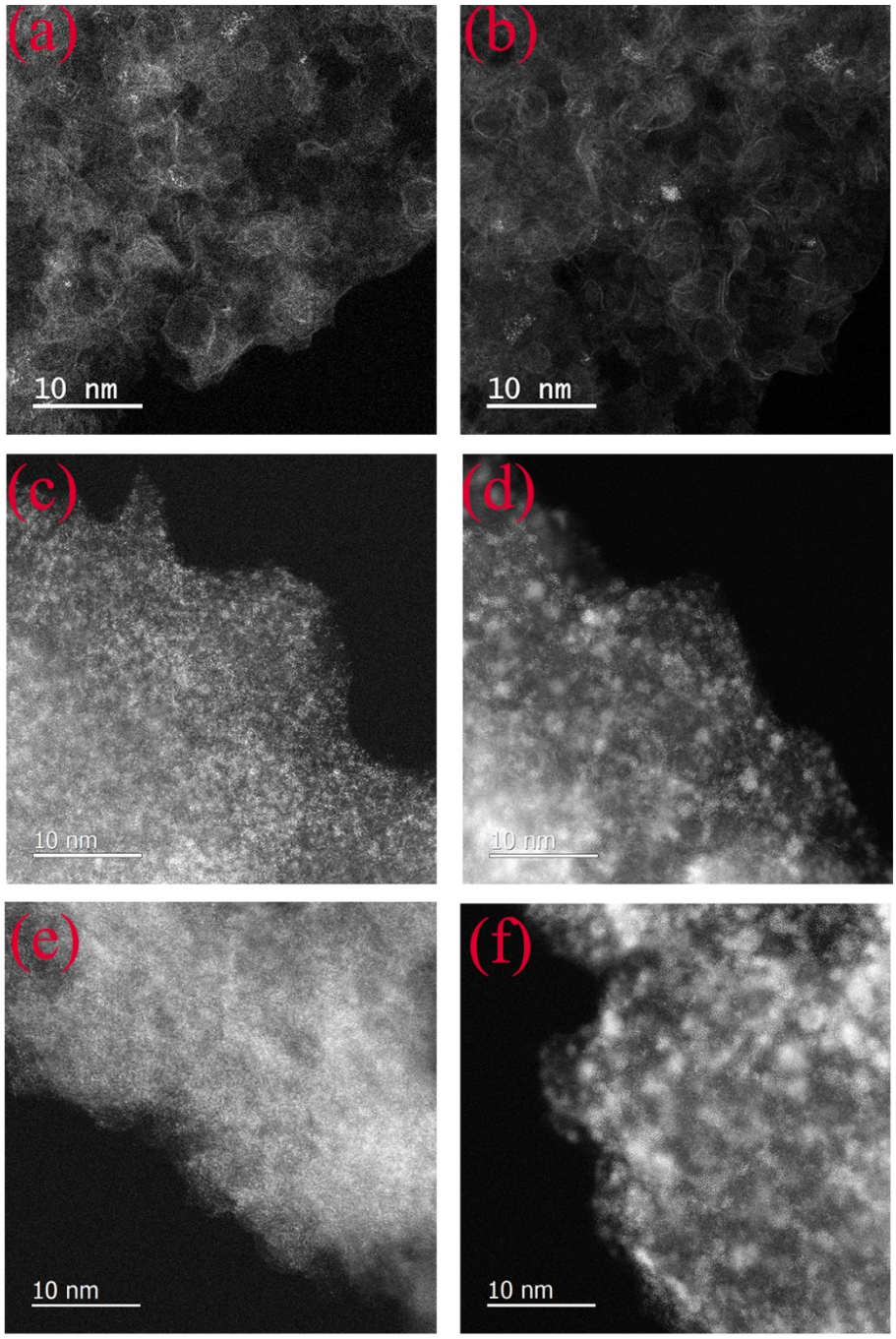


Fig. S4 HAADF-STEM images of the all catalysts.

Synthesis of activated carbon (AC) supported ruthenium catalysts with varying ruthenium particle size (dp (Ru)) via thermal activation at different temperatures, indicated in the sample code. HAADF-STEM images, with the respective metal particle size distribution, obtained from analysis of >150 particles, visualize a steady metal particle growth with an increasing activation temperature on carbon carriers.

Fig. S5 SEM images of the unreacted PDA catalysts.



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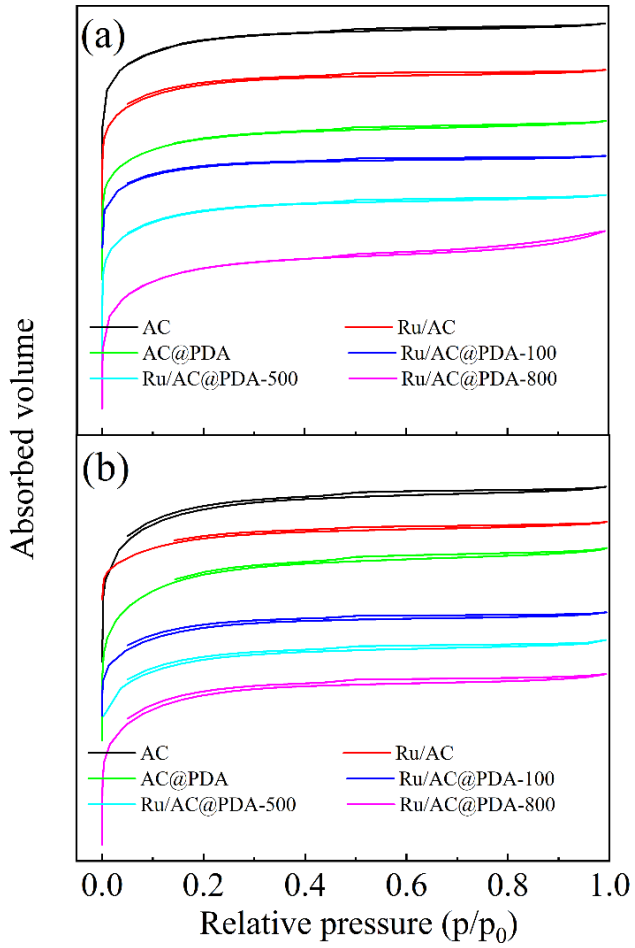
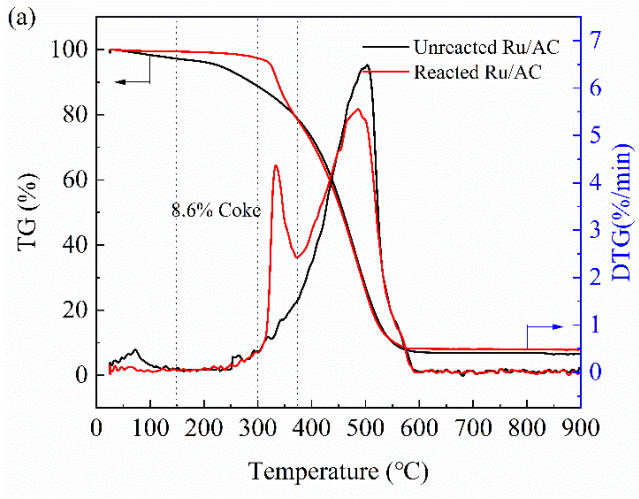
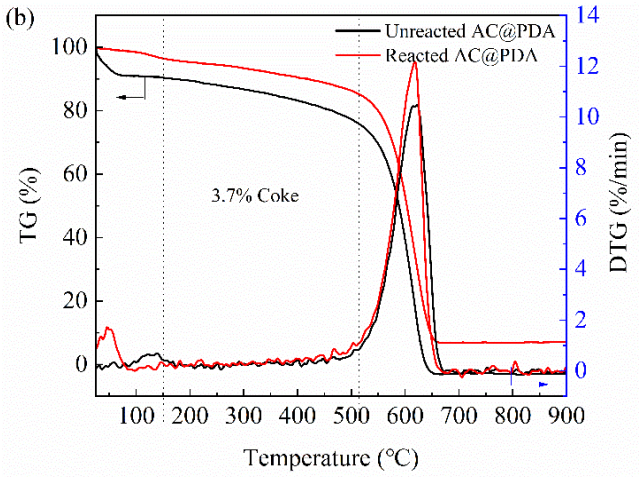
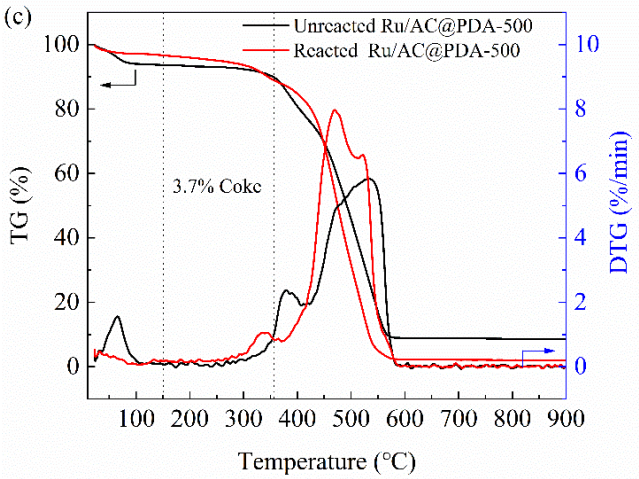


Fig. S7 Nitrogen adsorption-desorption isotherms of the(a) unreacted and (b) reacted catalysts.







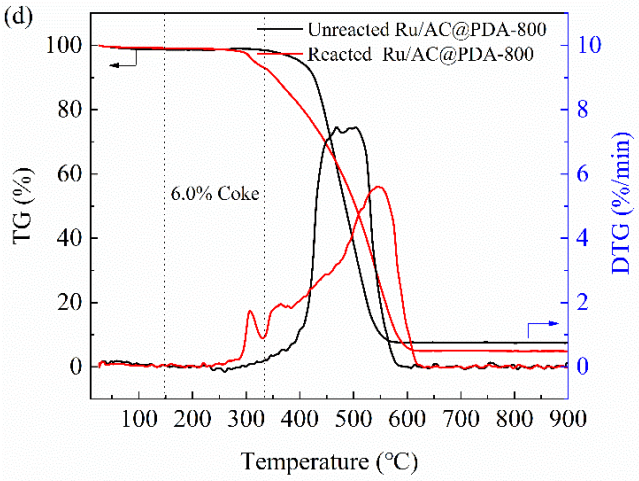


Fig. S8 TG curves of the unreacted and reacted catalysts recorded under air atmosphere.

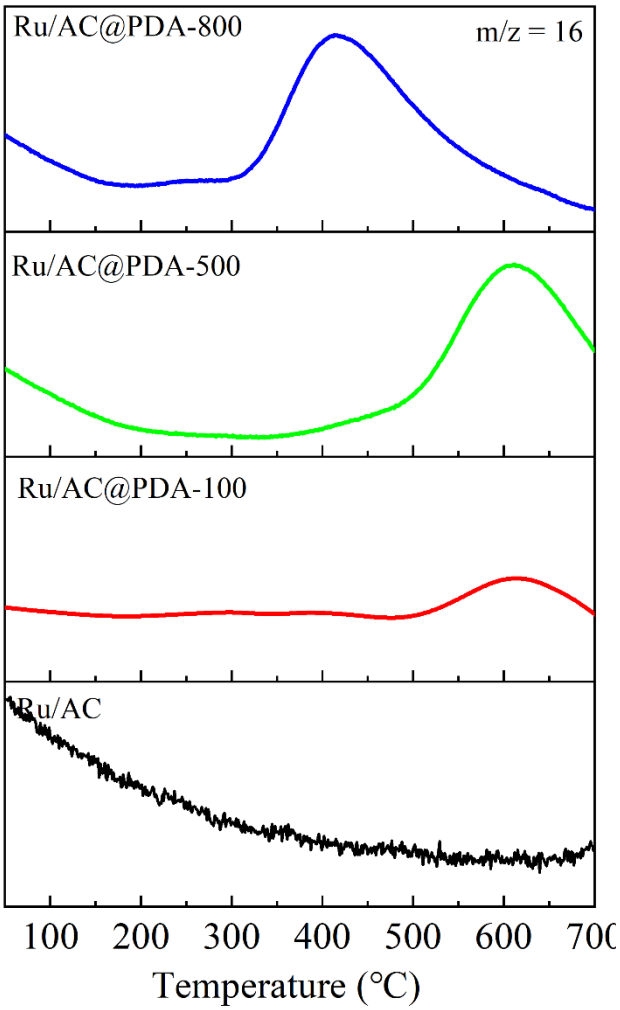


Fig. S9 MS spectra (m/z = 16) of the unreacted Ru catalysts.

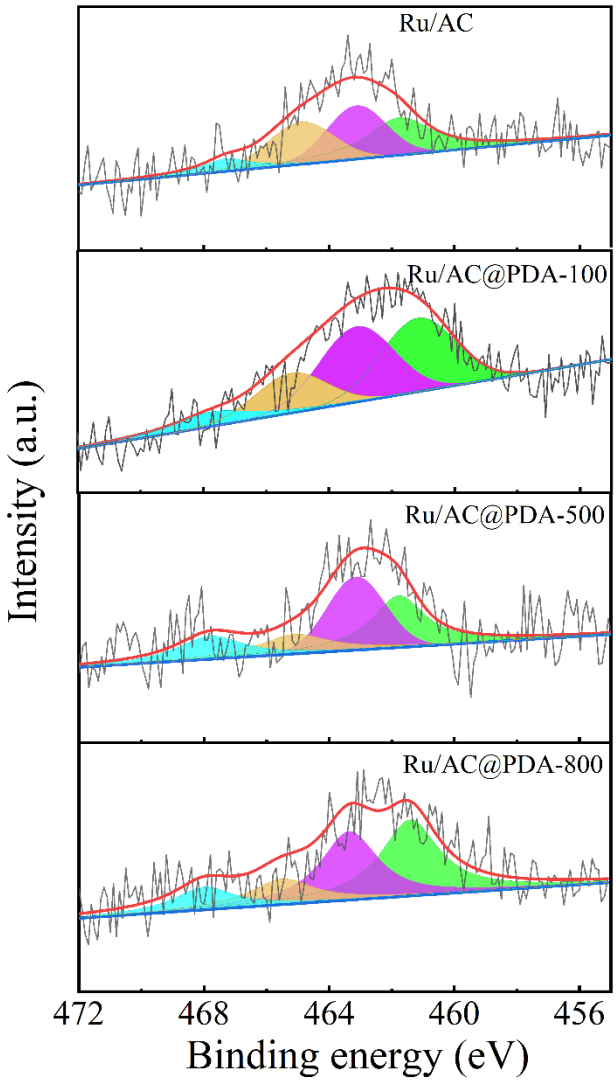


Fig. S10 Ru *3p* XPS spectra of the reacted Ru catalysts.

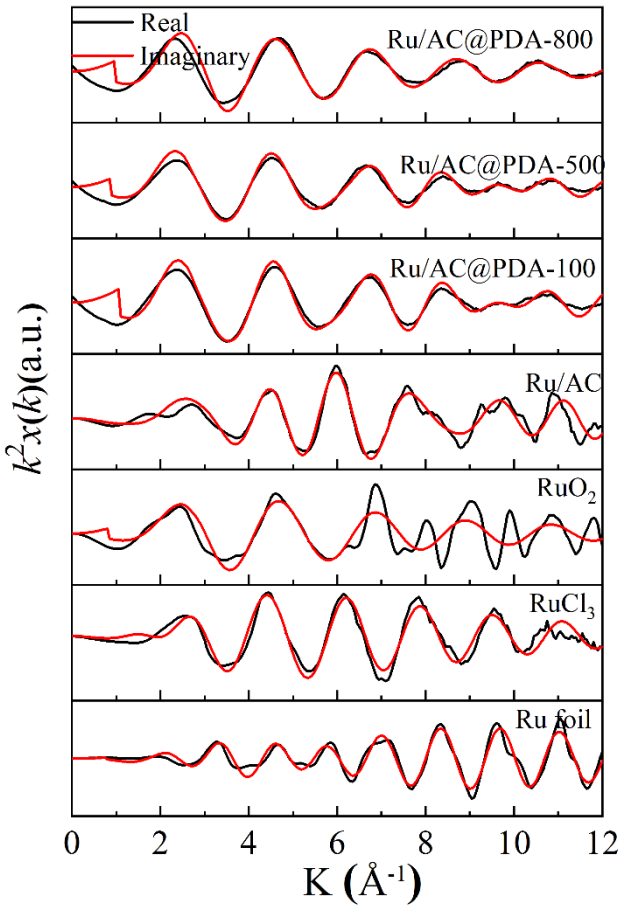


Fig. S11 The real/imaginary component of the FT with the scattering paths used in the fitting models.

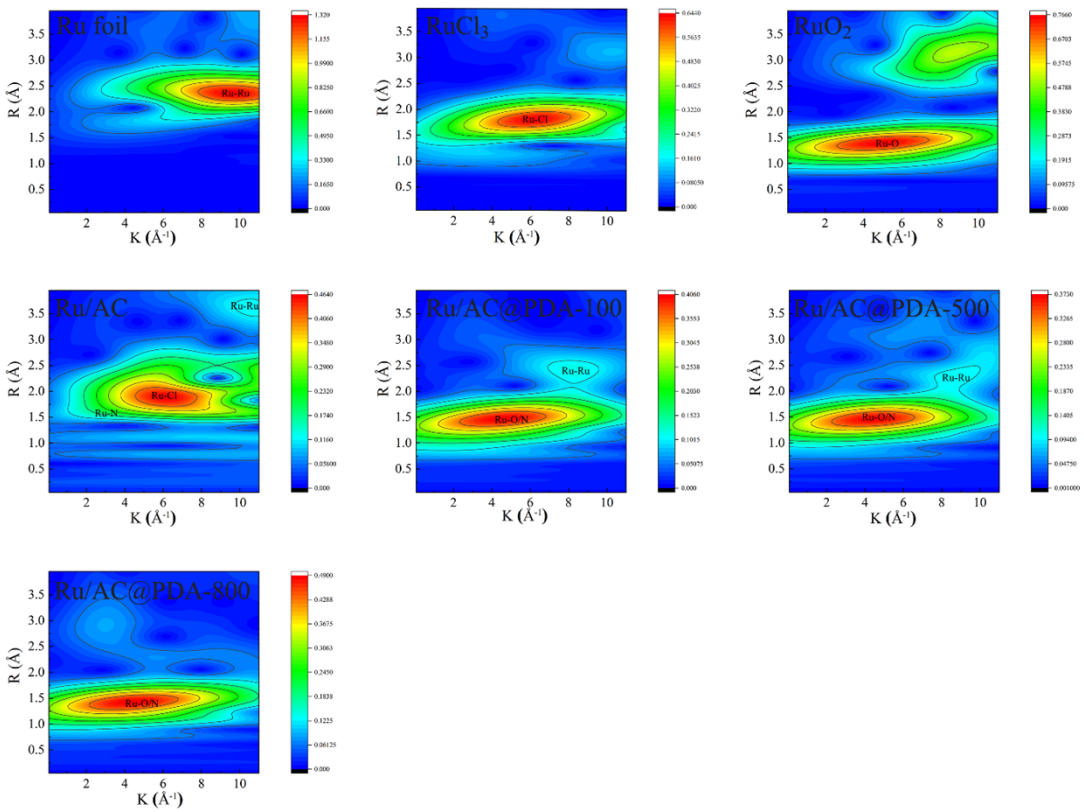
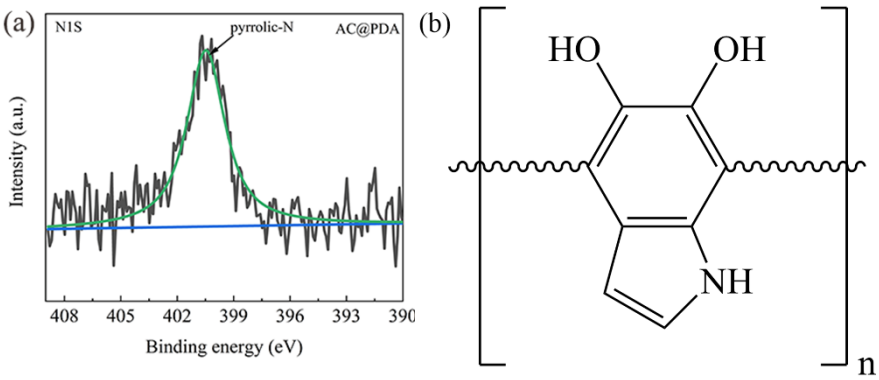


Fig. S12 Wavelet transform spectra of the Ru-based catalysts.



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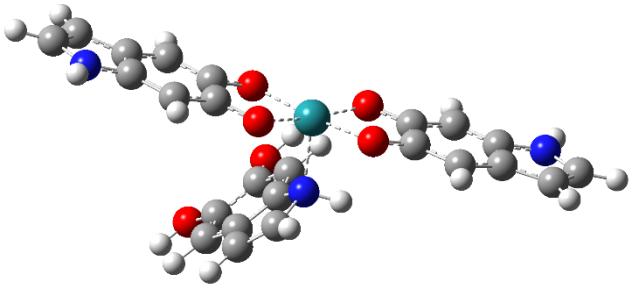

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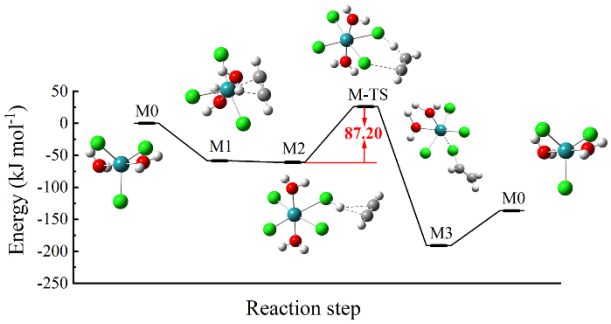

Fig. S15 Energy profiles of Ru/AC catalyst for acetylene hydrochlorination.

References

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