Electronic Supplementary Material (ESI) for Nanoscale.

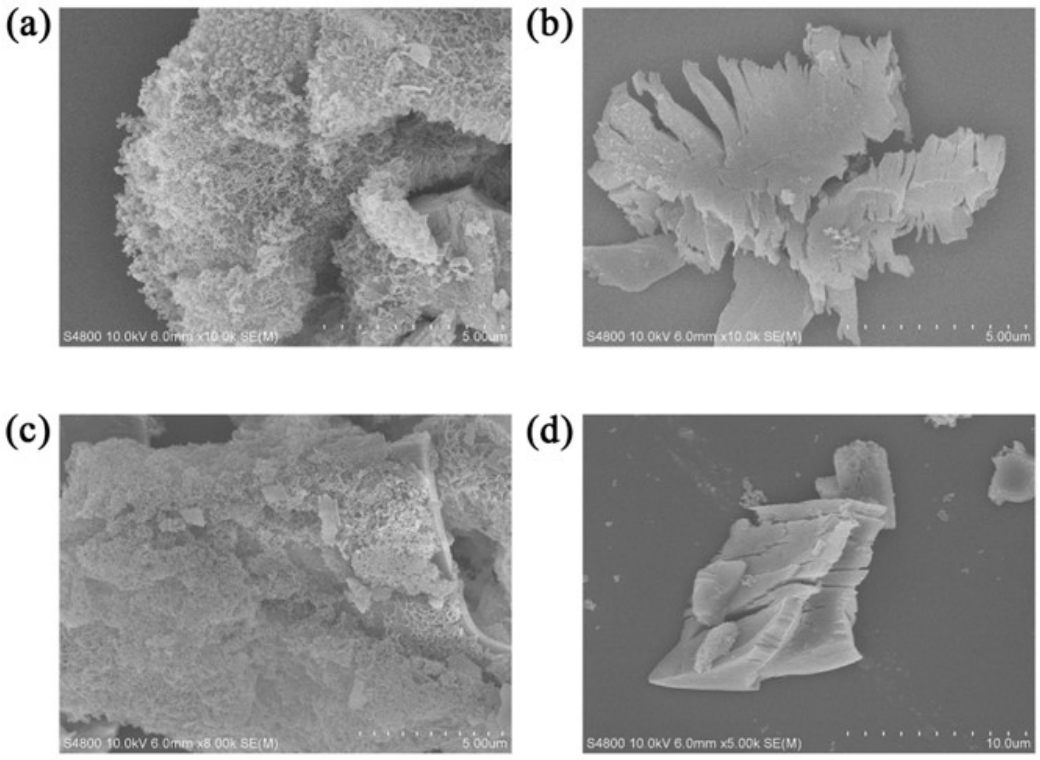

Fig. S1 SEM images of (a-b) siloxene, (c-d) PdCu/Siloxene.

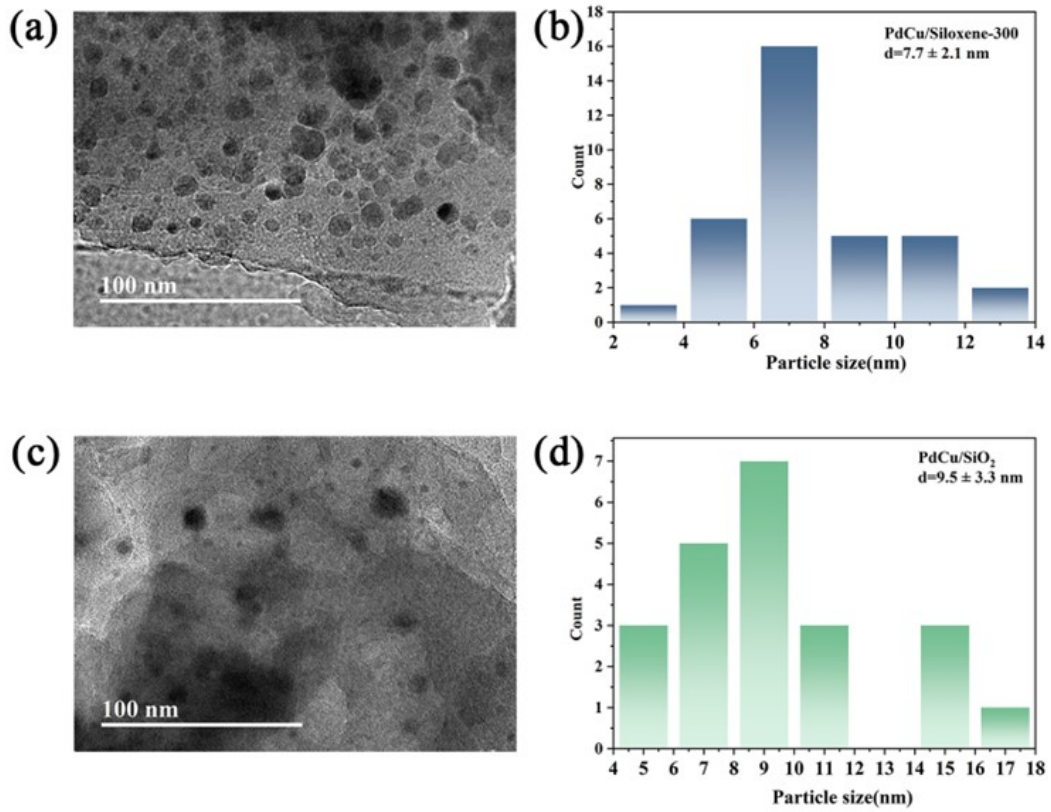

Fig. S2 (a) TEM image, (b) the diameter distribution of PdCu/Siloxene-300. (c) TEM image, (d) the diameter distribution of $PdCu/SiO_2$.

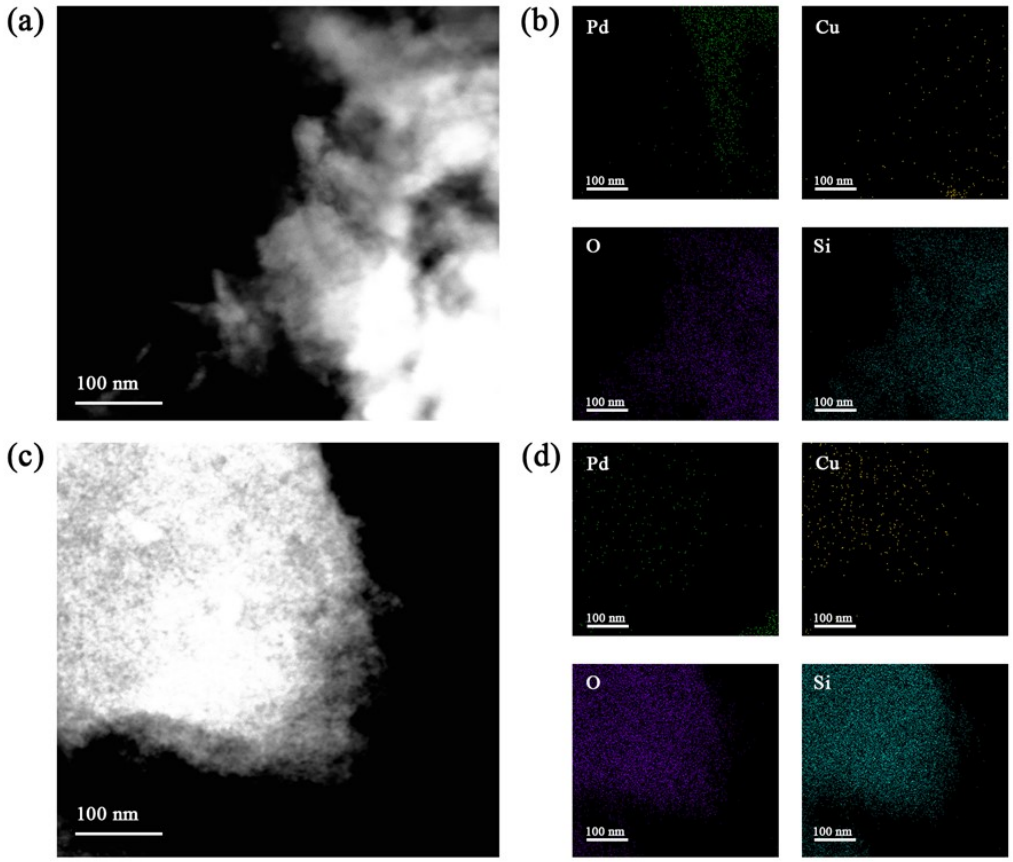

Fig. S3 (a) HAADF-STEM, (b) EDS mapping of PdCu/Siloxene-300. (c) HAADF-STEM, (d) EDS mapping of PdCu/SiO_2.

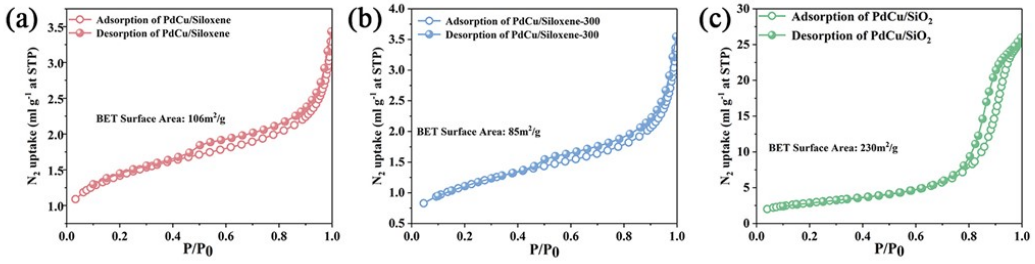

Fig. S4 BET surface area of (a) PdCu/Siloxene, (b) PdCu/Siloxene-300, and (c) PdCu/SiO_2.

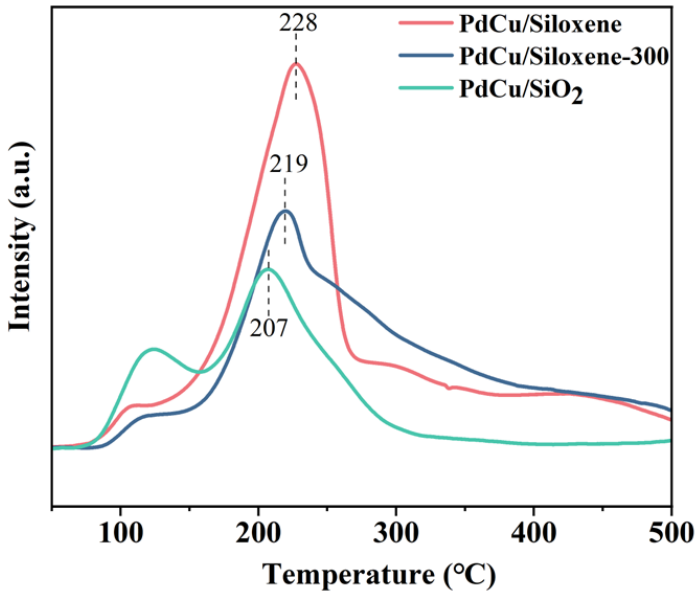

Fig. S5 H_2-TPR profiles of three catalysts.

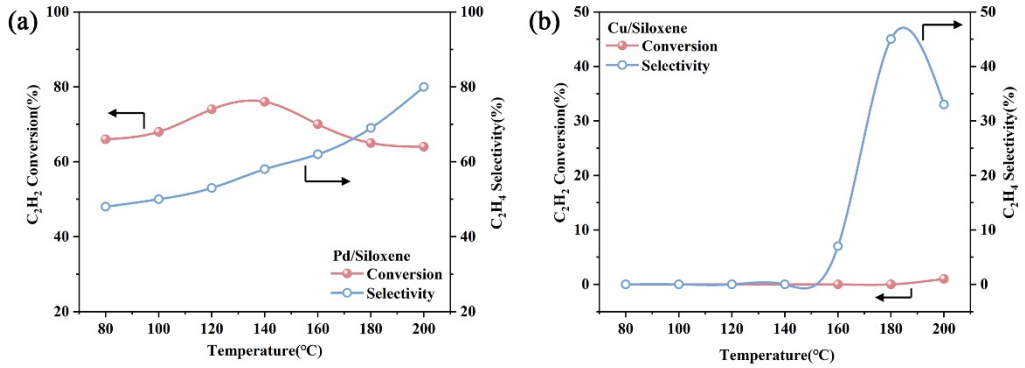

Fig. S6 Acetylene conversion and ethylene selectivity over (a) Pd/Siloxene and (b) Cu/Siloxene.

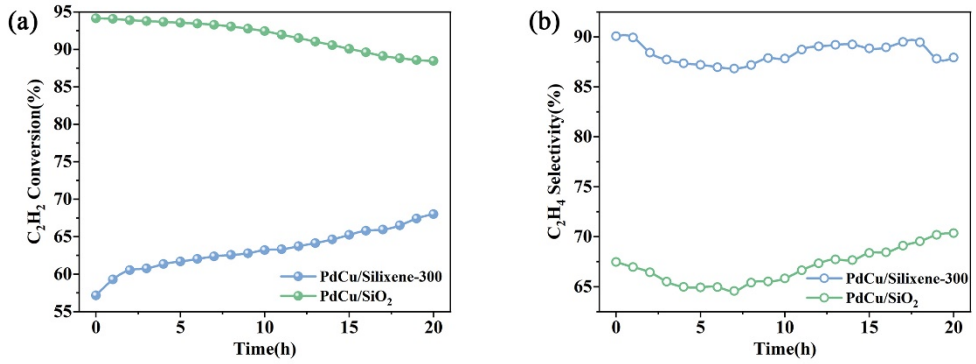

Fig. S7 Stability evaluation during a 20 hours test at 200 ℃ over PdCu/Siloxene-300 and PdCu/SiO_2: (a) acetylene conversion, (b) ethylene selectivity.

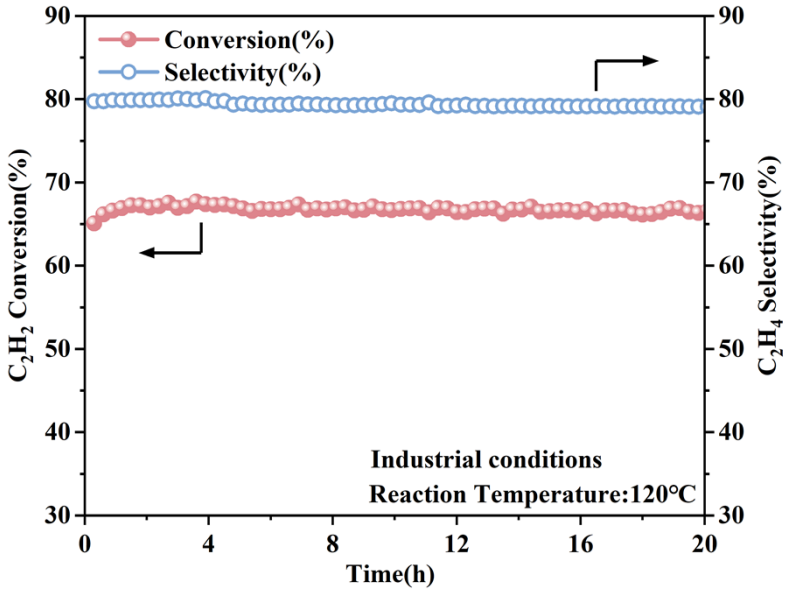

Fig. S8 Stability evaluation over PdCu/Siloxene under industrial conditions. (Reaction conditions: 1.0 % C_2H_2, 10.0 % H_2 and 20 % C_2H_4, with N_2 balance, total stream flow of 50 mL·min^{-1}; Reaction temperature=120 ℃.)

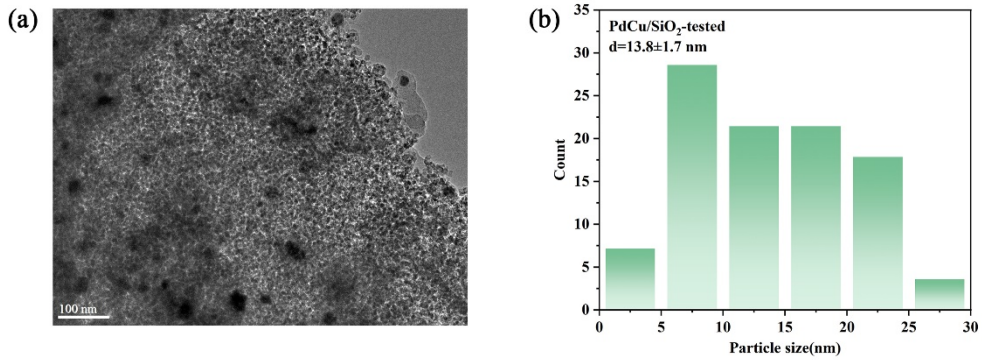

Fig. S9 (a) TEM image, (b) the diameter distributions of PdCu/SiO_2-tested.

Table S1. Metal loadings of the three different catalysts.

Sample	Metal loading	
	Cu (wt%)	**Pd (wt%)**
PdCu/Siloxene	3.2	0.1
PdCu/Siloxene-300	2.6	0.1
PdCu/SiO_2	2.5	0.1

Table S2. Long-term catalytic performance of different catalysts based semi-hydrogenation of acetylene.

Catalysts	Gas composition (vol. %)	Metal loading (wt. %)	Stability				Ref.
			Conversion (%)	Selectivity (%)	Temperature (℃)	Reaction time (h)	
PdCu/Siloxene	**C_2H_2 1.0 % / H_2 10 % / N_2 balance 50mL·min^{-1}**	**Pd 0.1 Cu 3.2**	**~ 93**	**~ 91**	**200**	**39**	**This work**
$Pd/Bi_2O_3/TiO_2$	C_2H_2 1 % / H_2 20 % /C_2H_4 20 % /N_2 balance 60mL·min^{-1}	Pd 2.3 Bi 4.9	~ 64	~ 93	40	24	[1]
CuB2 CuPd-2	C_2H_2 0.5 % / H_2 5% /C_2H_4 10 % /Ar balance 50mL·min^{-1}	N.A.	~ 92.5	~ 87.7	80	24	[2]
$Pd_1Cu_1/ND@G$	C_2H_2 1 % / H_2 10 % /C_2H_4 20 % /He balance 30mL·min^{-1}	Pd 0.09 Cu 0.49	~ 68	~ 92	90	100	[3]
$Pd/MgAl_2O_4$	C_2H_2 1 % / H_2 5 % /C_2H_4 20 % /Ar balance 40 mL·min^{-1}	Pd 0.1	~ 90	~ 83	120	50	[4]
$Ni_3ZnC_{0.7}/C$	C_2H_2 1 % / H_2 15 % /N_2 balance 100mL·min^{-1}	Ni_3Zn 2	~ 95	~ 85	160	10	[5]
$CuPd_{0.006}/SiO_2$	C_2H_2 1.0 % / H_2 20.0 % /C_2H_4 20.0 % /He balance 30mL·min^{-1}	Cu 4.96 Pd 0.0494	~ 99	~ 45	160	24	[6]
Pd-His/SiO_2	C_2H_2 1 % / H_2 10 % /Ar balance 30mL·min^{-1}	Pd 0.48	~ 100	~ 76 to ~ 81	160	50	[7]
Pt_3Fe/SiO_2	C_2H_2 1 % / H_2 2 % / He balance 50mL·min^{-1}	Pt 18.9 Fe 1.7	~ 99	~ 83	180	40	[8]
$NiCu/ZrO_2$	C_2H_2 1 % / H_2 10 % /C_2H_4 20 % /Ar balance 40mL·min^{-1}	Ni 4.6 Cu 4.8	~ 100	~ 94 to ~ 91	220	15	[9]

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