

Supporting Information

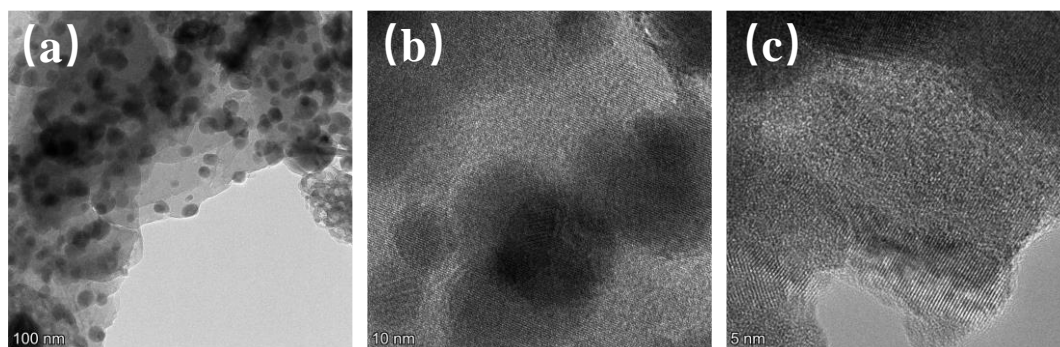


Fig. S1 HR-TEM images of NiCu/10%Mo- NbOPO₄

Table S1 Results of the Mo content of the modified supports

Sample	Sampling amount(g)	Constant volume V0(mL)	Test elements	Element concentration C0(mg/L)	Elemental content wt. (%)
5%Mo- NbOPO ₄	0.0343	25	Mo	29.88	2.18
	0.0343	25	Mo	29.90	2.18
	0.0343	25	Mo	29.88	2.18
10%Mo- NbOPO ₄	0.0335	25	Mo	55.48	4.14
	0.0335	25	Mo	55.48	4.14
	0.0335	25	Mo	55.47	4.14
15%Mo- NbOPO ₄	0.0363	25	Mo	84.87	5.84
	0.0363	25	Mo	84.97	5.85
	0.0363	25	Mo	85.04	5.86

Table S2 Theoretical and practical content of modified supports

Sample	Practical elemental content wt. (%)	Theoretical elemental content wt. (%)	Error (%)
5%Mo-NbOPO ₄	2.18	2.72	19.85
10%Mo- NbOPO ₄	4.14	5.29	21.74
15%Mo- NbOPO ₄	5.85	7.73	24.32

Table S3 Crystallite and average size from XRD

	Peak Position (2 Theta)	FWHM (Full width at half maximum)	Crystallite Size D(nm)	D nm (Average)
Cu	43.33	0.258	33.13	30.26
	50.46	0.377	23.29	
	74.14	0.290	34.38	
Ni	44.65	0.324	26.49	29.17
	76.58	0.266	38.04	
	51.88	0.386	22.98	

Table S4 The catalytic activities for HDO of oleic acid over different catalysts ^a

Catalysts	Conversion (%)	Selectivity (%)	
		Heptadecane	Octadecane
Ni/NbOPO ₄	62.87	22.88	12.34
NiCu/NbOPO ₄	70.87	14.23	16.52
NiCu/5%Mo-NbOPO ₄	70.94	7.68	24.59
NiCu/10%Mo-NbOPO ₄	81.39	8.18	52.03
NiCu/15%Mo-NbOPO ₄	82.48	7.12	49.24

^a Reaction conditions: catalyst 0.5 g, oleic acid 2.5 g, reaction temperature 230 °C reaction time 7 h, initial H₂ pressure 3.0 MPa.

Table S5 Effects of H₂ initial pressure on HDO reaction of oleic acid

Catalyst	H ₂ Pressure (MPa)	Conversion (%)	Selectivity (%)	
			Heptadecane	Octadecane
NiCu/NbOPO ₄	2	99.53	36.00	27.33
	3	99.52	39.06	53.10
	4	99.53	27.69	54.67
	5	99.55	24.46	58.18

Reaction conditions: catalyst 0.5 g, oleic acid 2.5 g, reaction temperature 260 °C reaction time 7 h.

Table S6 Effects of reaction time on HDO reaction of oleic acid

Catalyst	Time (h)	Conversion (%)	Selectivity (%)	
			Heptadecane	Octadecane
NiCu/NbOPO ₄	5	90.33	28.57	35.64
	6	93.33	32.20	37.51
	7	99.52	39.06	53.10
	8	99.52	41.02	47.56
	9	99.52	43.19	46.43

Reaction conditions: catalyst 0.5 g, oleic acid 2.5 g, reaction temperature 260 °C, initial H₂ pressure 3.0 MPa.

Table S7 Results of metal residues in the liquid phase of the NiCu/10Mo%-NbOPO₄ catalyst

Sample	Sampling amount (mL)	Constant volume V0 (mL)	Test elements	Element concentration C0(mg/L)	Dilution factor (f)	Element concentration (original sample solution) C1 (mg/L)
NiCu/10Mo% -NbOPO ₄	1	10	Ni	0.188	10	1.88
	1	10	Ni	0.188	10	1.88
	1	10	Ni	0.19	10	1.90
Liquid phase products	1	10	Cu	0.008	10	0.08
	1	10	Cu	0.006	10	0.06
	1	10	Cu	0.007	10	0.07