

Supporting Information

Morphology-maintaining synthesis of NbN and its catalytic performance in epoxidation

Tiaohao Zhao,^a Shanshan Shen,^a Xiaohui Liu,^{*a} Yong Guo,^a Chih-Wen Pao,^b Jeng-Lung Chen^b and Yanqin Wang^{*a}

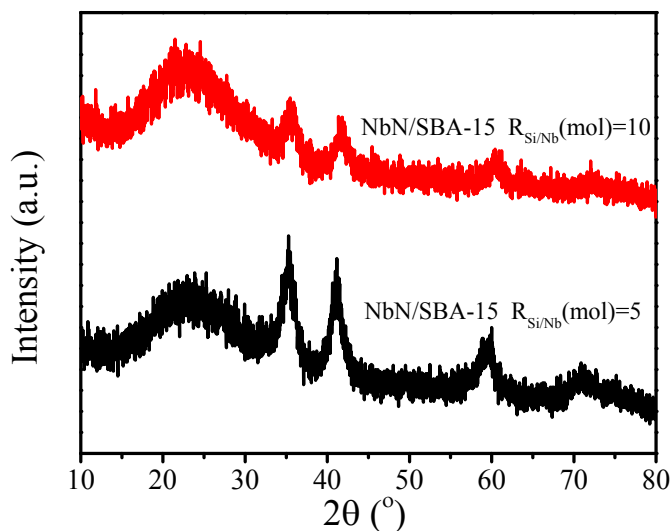


Figure S1. XRD patterns of the NbN/SBA-15 with different Si/Nb mol ratio. Nitridation condition: T=750 °C, R_{urea/Nb}(mol)=16.

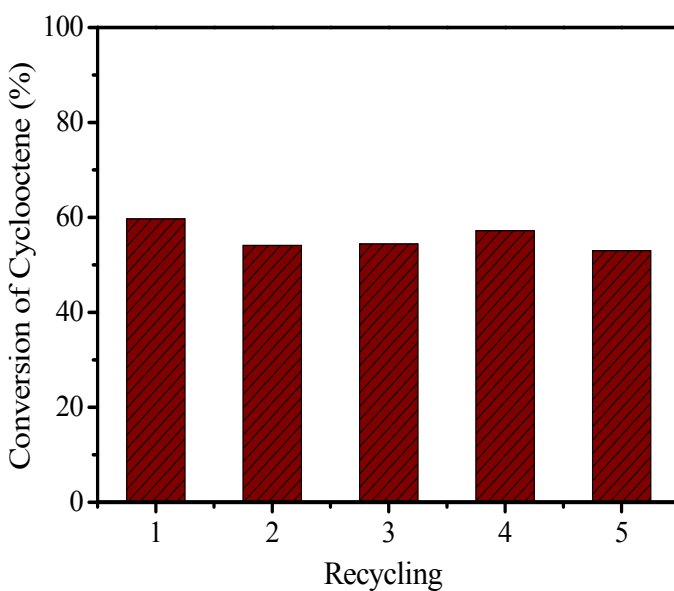


Figure S2. The recyclability experiments of NbN-16 in the epoxidation of cyclooctene. Reaction condition: cyclooctene (1 mmol), catalyst (0.025 g), diethylhexanol (1 mmol), CH₃OH (5 mL), 60 °C, H₂O₂ (6 mmol), 0.5 h.

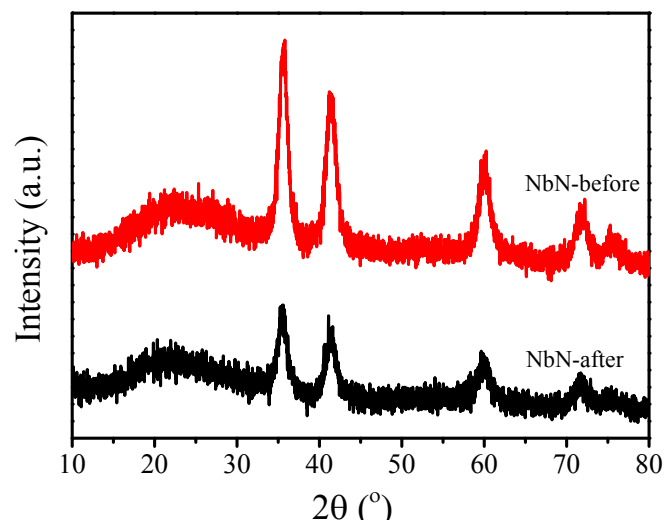


Figure S3. XRD patterns of the NbN-16 and the used catalyst after the recyclability experiments.

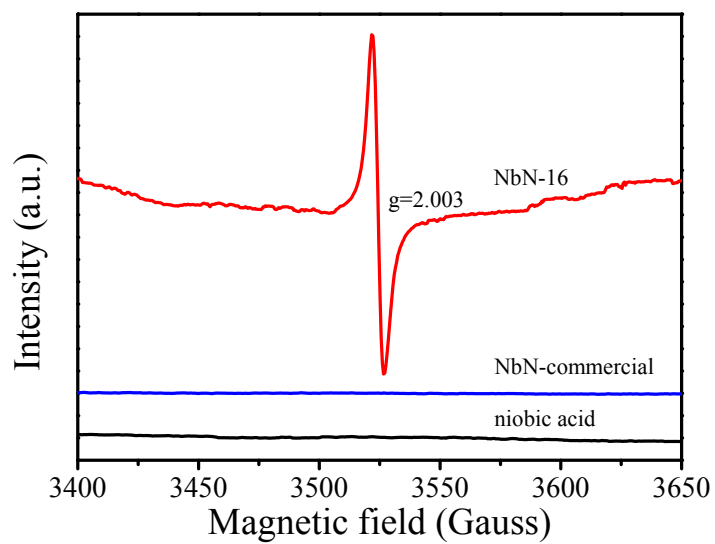


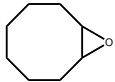

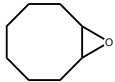



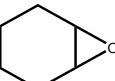
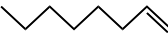



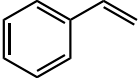
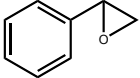
Figure S4. EPR spectra of niobic acid, NbN-16 and NbN-commercial.

Table S1. Epoxidation reaction of cyclooctene with different time

Catalyst	Time (h)	Conversion (%)	Yield of Epoxycyclooctane (%)	Carbon Balance (%)
NbN-16	4	98.1	93.9	95.8
NbN-16	2	96.4	91.1	94.7
NbN-16	1	90.3	86.4	96.1
NbN-16	0.5	84.5	80.0	95.5

Reaction condition: 0.025 g of catalyst, 1 mmol of cyclooctene, 6 mmol of H₂O₂, 1 mmol of diethylhexanol (internal standard), 5 mL of CH₃OH, 60 °C.

Table S2. Epoxidation reaction of different epoxides over NbN and niobic acid ^a

	Substrate		Selectivity (%)		Conversion (%)	
			NbN	niobic acid	NbN	niobic acid
1			99	99	96.4	46.8
2			97.5	63.6	77.8	54.6
3			83.3	84.6	43.7	13.5
4			99	99	22.3	5.2
5			99	99	18.6	4.3
6 ^b			71.4	43.4	75.1	42.1

Reaction condition: 0.025 g of catalysts, 1 mmol of substrate, 6 mmol of H₂O₂, 5 mL of CH₃OH, 60 °C, a: t=2 h. b: t=12 h.

Table S3. Epoxidation reaction of cyclooctene over Nb-SBA-15 catalysts ^a

Solvent	Catalysts	H ₂ O ₂ (mmol)	Time (h)	Conversion (%)
CH ₃ OH	Nb-O-SBA-15-5 ^b	1	0.5	5.4
CH ₃ OH	Nb-N-SBA-15-5 ^c	1	0.5	30.7

Notes: ^a Reaction conditions: 0.025 g of catalyst, 1 mmol of cyclooctene, 1 mmol of H₂O₂, 1 mmol of diethyl hexanol (internal standard), 5 mL of CH₃OH, 60 °C, 0.5 h. ^b The Si/Nb mol ratio of Nb-O-SBA-15-5 is 5. ^c Nitridation condition: T=750 °C, R_{urea/Nb}(mol)=16.