Supplementary Material

Rare-earth Ions Exchanged Cu-SSZ-13 Zeolite from Organotemplate-free Synthesis with Enhanced Hydrothermal Stability in NH_3-SCR of NO_x

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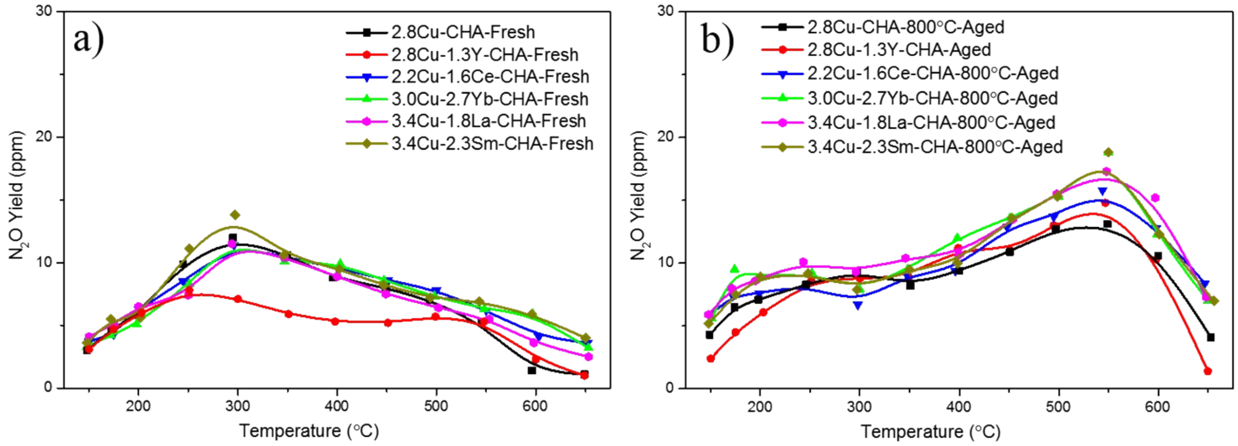

Figure S1. N_2O yields as a function of temperature on rare-earth ions exchanged Cu-SSZ-13(4): (a) Fresh and (b) 800 °C aged. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 10% O_2, 5 vol.% H_2O, balance N_2; GHSV=80, 000 h^{-1}.

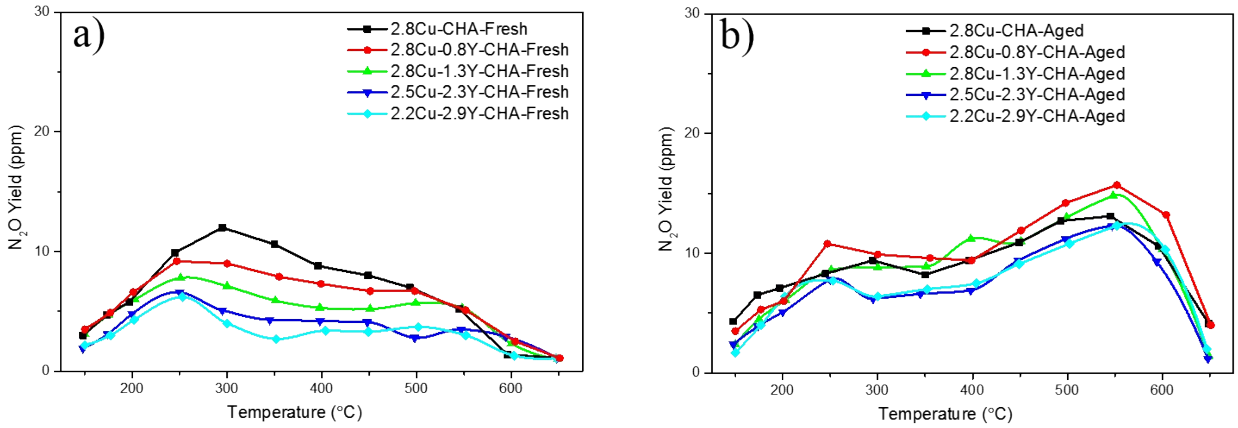

Figure S2. N_2O yields as a function of temperature on fresh and hydrothermally aged Al-rich Cu-Y-SSZ−13(4) catalysts with different amount of Y. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 10% O_2, 5% H_2O, balance N_2; GHSV=80, 000 h^{-1}.

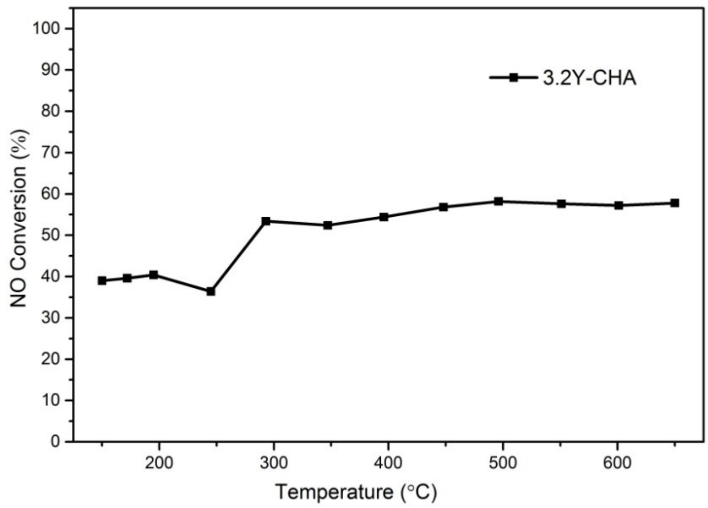

Figure S3. NO conversions as a function of temperature on Y-SSZ-13(4). Reaction conditions: 500 ppm NO, 500 ppm NH_3, 10% O_2, 5 % H_2O, balance N_2; GHSV=80, 000 h^{-1}.

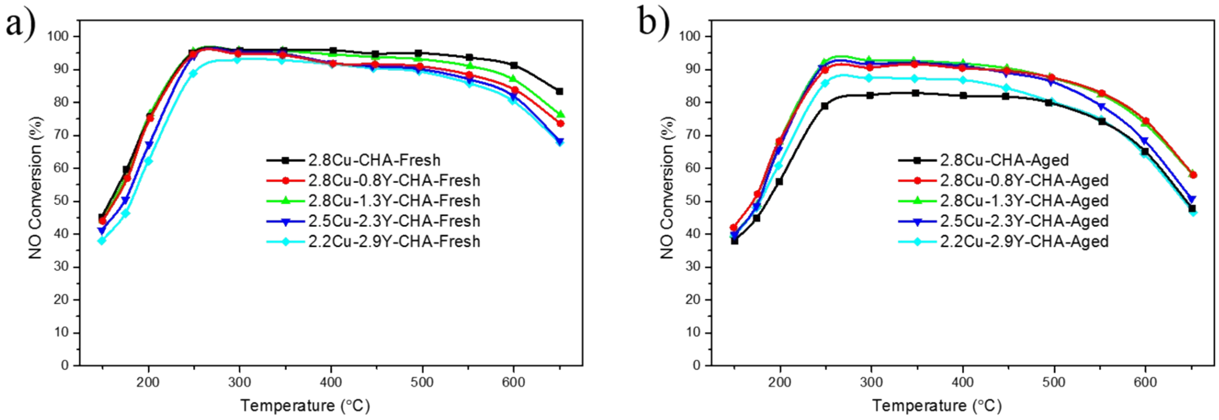

Figure S4. NO conversions as a function of temperature on fresh and hydrothermally aged Al-rich Cu-Y-SSZ-13(4) catalysts with different amount of Y. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 10% O_2, 5% H_2O, balance N_2; GHSV= 400, 000 h^{-1}.

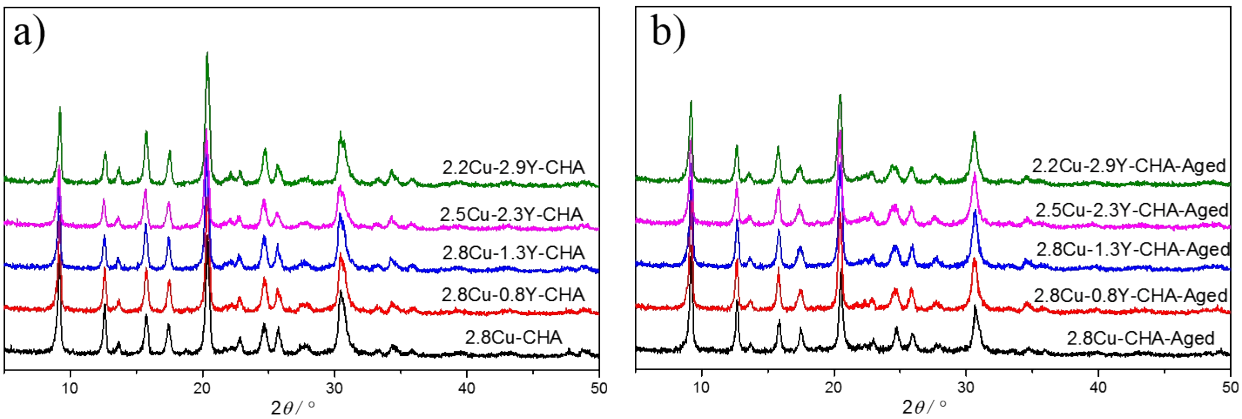

Figure S5. XRD patterns of Cu-Y-SSZ-13(4) catalysts: fresh (a) and hydrothermally aged (b).

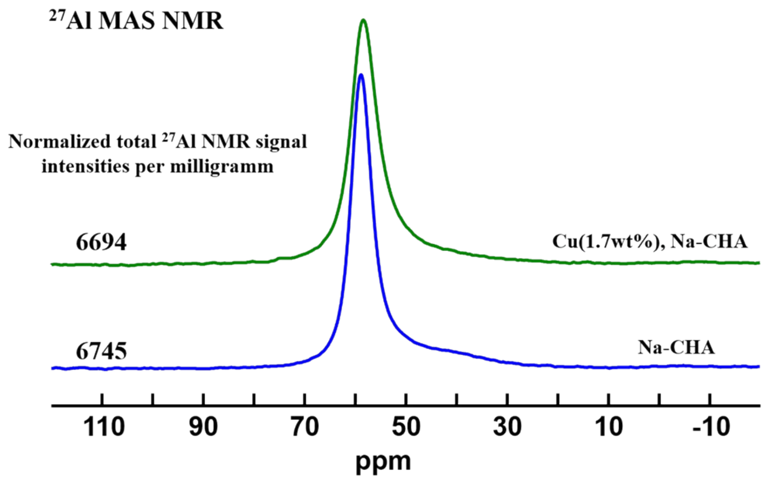

Figure S6 ^{27}Al MAS NMR spectra of Na-SSZ-13 and Cu-Na-SSZ-13.

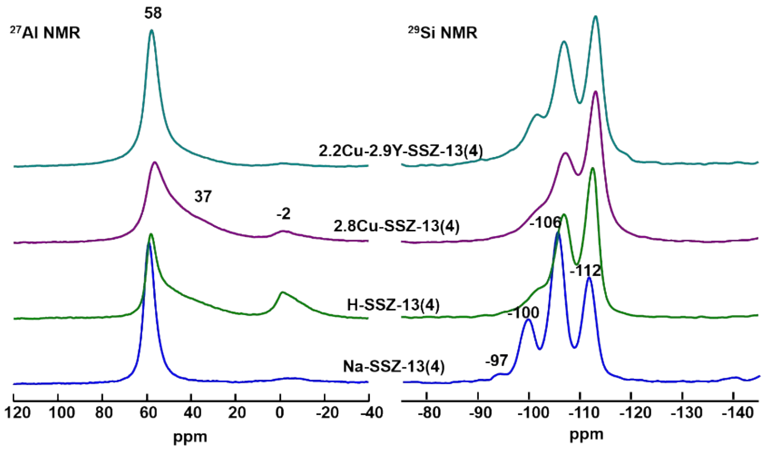

Figure S7. ^{27}Al and ^{29}Si MAS NMR spectra of parent Na-SSZ-13(4), H-type SSZ-13(4), Cu-exchanged SSZ-13(4) and Cu,Y-exchanged SSZ-13(4).

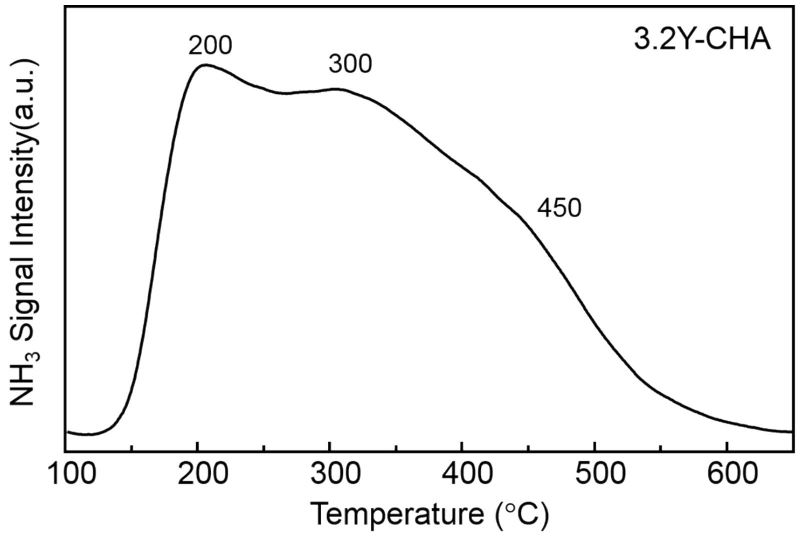

Figure S8. NH_3-TPD profiles of 3.2Y-H-SSZ-13(4).

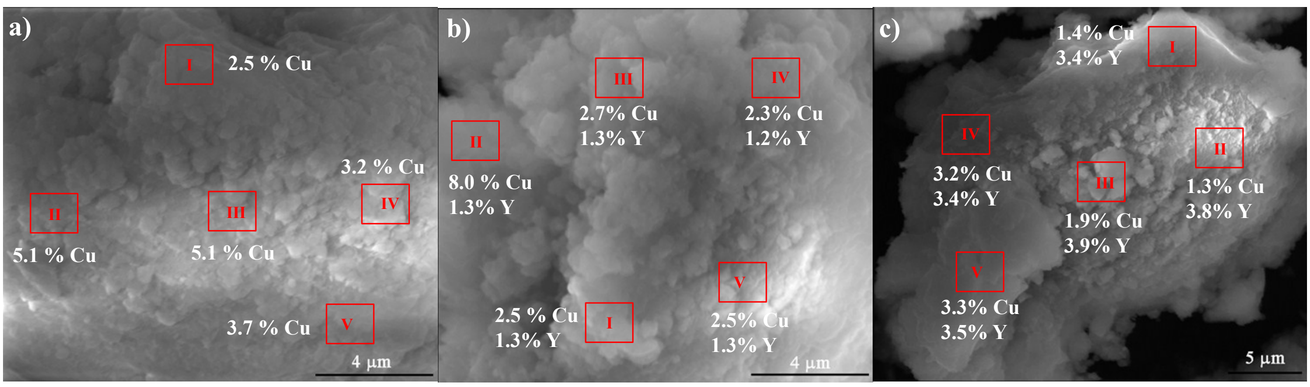

Figure S9. SEM-EDX results of representative Cu-Y-SSZ-13 catalysts: (a) 2.8Cu-CHA; (b) 2.8Cu-1.3Y-CHA and (c) 2.2Cu-2.9Y-CHA. Cu distributions are inhomogeneous, and even unexpected high Cu contents above 5 wt% are observed for these catalysts, which may result from minor highly dispersed CuO species also identified by H_2-TPR.

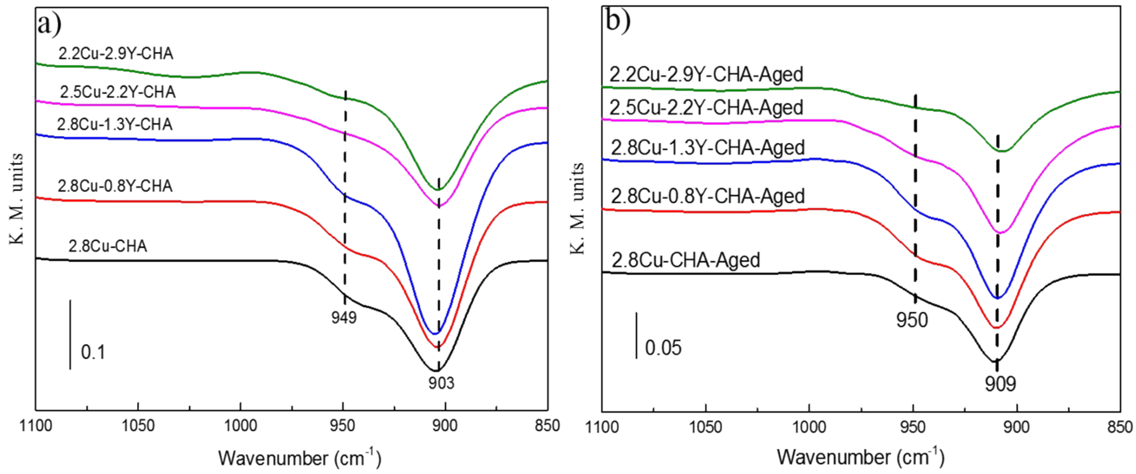

Figure S10. DRIFT spectra of fresh (a) and aged (b) Cu-Y-SSZ-13 zeolites with NH_3 exposure time of 30 min.

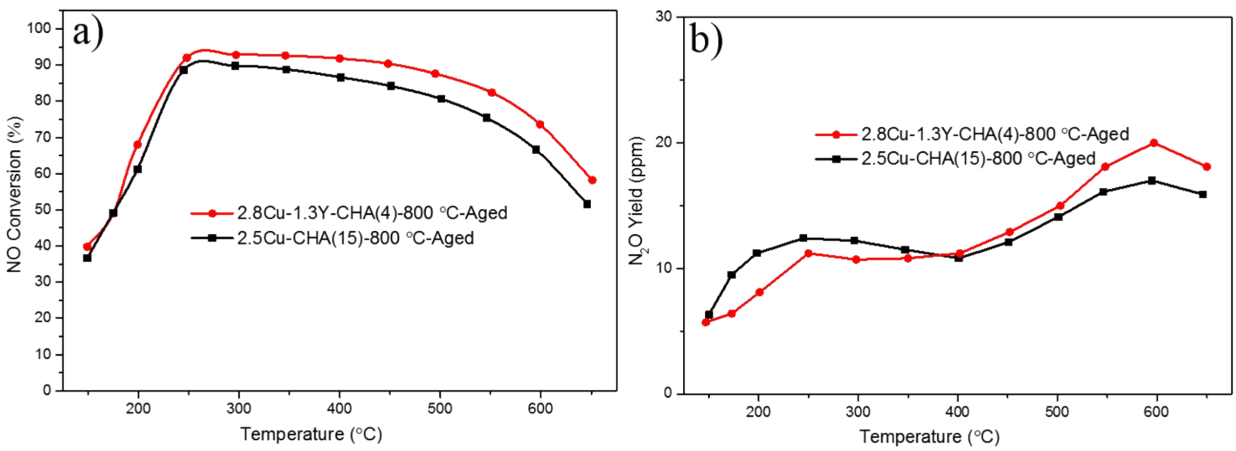

Figure S11. NO conversions (a) and N_2O yields (b) as a function of temperature for hydrothermally aged Al-rich 2.8Cu-1.3Y-SSZ-13 and organotemplated high-silica 2.5Cu-SSZ-13(15) catalysts. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 10% O_2, 5% H_2O, balance N_2; GHSV=400, 000 h^{-1}.

Table S1 Concentration of Brönsted acid sites in fresh and aged Cu-Y-CHA catalysts derived from quantitative ^{1}H MAS NMR measurements

Sample	Fresh (mmol/g zeolite)	Aged (mmol/g zeolite)
2.8Cu-CHA	0.46	0.01
2.8Cu-0.8Y-CHA	0.41	0.01
2.8Cu-1.3Y-CHA	0.43	0.04
2.5Cu-2.3Y-CHA	0.41	0.04
2.2Cu-2.9Y-CHA	0.64	0.07

Table S2 Normalized reaction rates ($\times 10^{-3}$ mol NO · mol^{-1}Cu · s^{-1}) of Al-rich Cu-Y-CHA catalysts.

	2.8Cu-CHA	**2.8Cu-0.8Y-CHA**	**2.8Cu-1.3Y-CHA**	**2.5Cu-2.3Y-CHA**	**2.2Cu-2.9Y-CHA**
150 °C	4.3[a] (3.6)	4.2 (4.0) [b]	4.2(3.8)	4.4(4.3)	4.6(4.7)
175 °C	5.7(4.3)	5.4(5.0)	5.5(4.7)	5.4(5.2)	5.6(5.8)
200 °C	7.2(5.3)	7.2(6.5)	7.3(6.5)	7.2(7.0)	7.5(7.4)

[a]: Fresh catalyst; [b]: 800 °C aged catalysts. Reaction conditions: 500 ppm NO, 500 ppm NH_3, 10% O_2, 5% H_2O, balance N_2; GHSV=400, 000 h^{-1}.