Promotion effect of cerium doping on iron-titanium composite oxide catalyst for selective catalytic reduction of NO_x with NH_3

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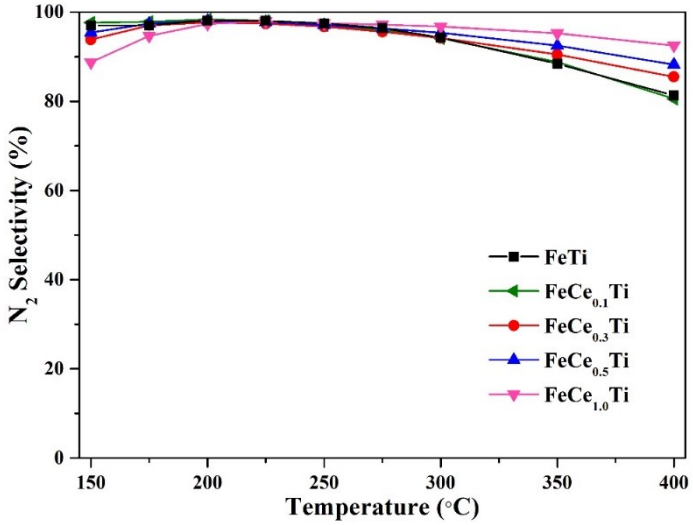

Fig. S1 N_2 selectivity over FeTi and $FeCe_aTi$ catalysts calcined at 500 °C. Reaction conditions: [NO] = [NH_3] = 500 ppm, [O_2] = 5 vol.%, N_2 balance, and GHSV=250,000 h^{-1}.

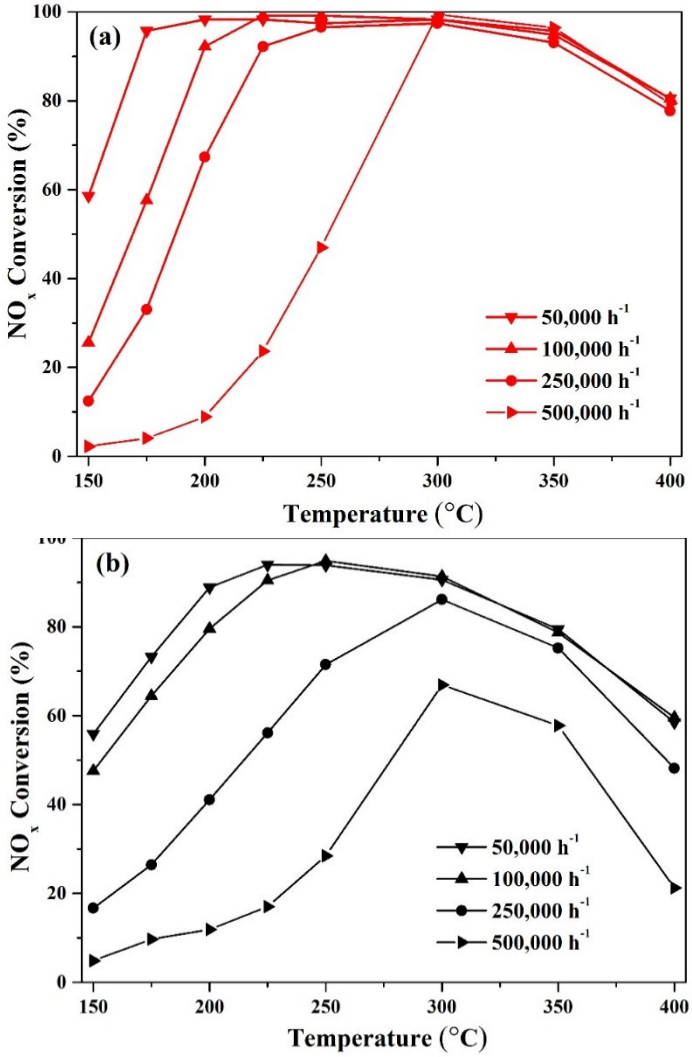

Fig. S2 NO_x conversion over (a) $FeCe_{0.3}Ti$ and (b)FeTi catalysts calcined at 500 °C. Reaction conditions: [NO] = [NH_3] = 500 ppm, [O_2] = 5 vol.%, N_2 balance, and GHSV from 50,000 to 500,000 h^{-1}.

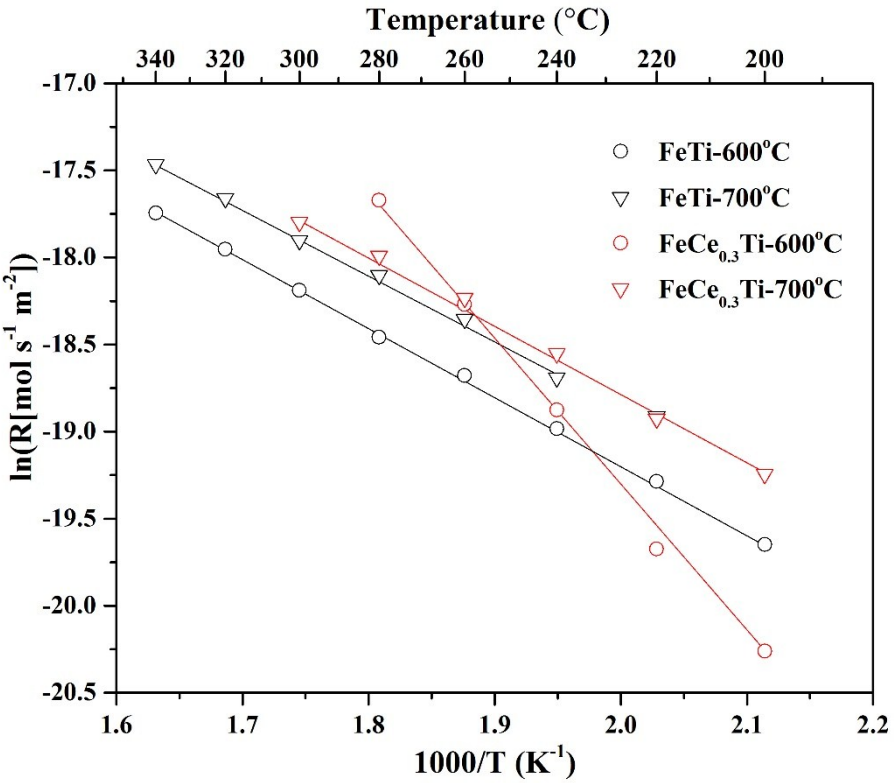

Fig. S3 Arrhenius plots of the reaction rates over FeTi and $FeCe_aTi$ catalysts calcined at 600 °C and 700 °C, respectively. Reaction conditions: [NO] = [NH_3] = 500 ppm, [O_2] = 5 vol.%, N_2 balance.

Table S1 Activation energy, pre-exponential factor and R^2 of FeTi and $FeCe_{0.3}Ti$ catalysts calcined at 500 °C, 600 °C, and 700 °C, respectively.

	E_a (kJ mol^{-1})	A (molecules per m^2 s)	R^2
FeTi	28.8	7.2×10^{18}	0.994
FeTi-600 °C	32.6	7.1×10^{18}	0.999
FeTi-700 °C	30.8	1.1×10^{18}	0.998
$FeCe_{0.3}Ti$	47.5	1.9×10^{21}	0.991
$FeCe_{0.3}Ti$-600 °C	71.6	1.2×10^{22}	0.997
$FeCe_{0.3}Ti$-700 °C	36.1	1.8×10^{19}	0.996

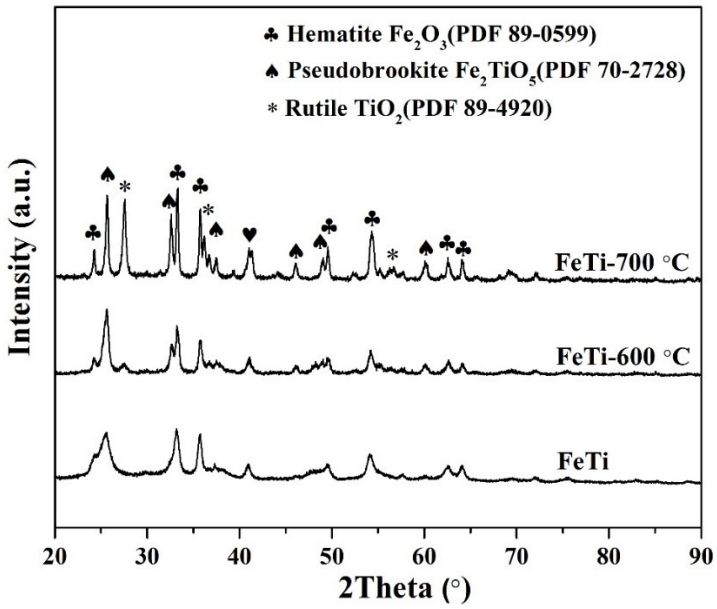

Fig. S4 XRD patterns of FeTi catalysts calcined at 500 °C, 600 °C, and 700 °C.

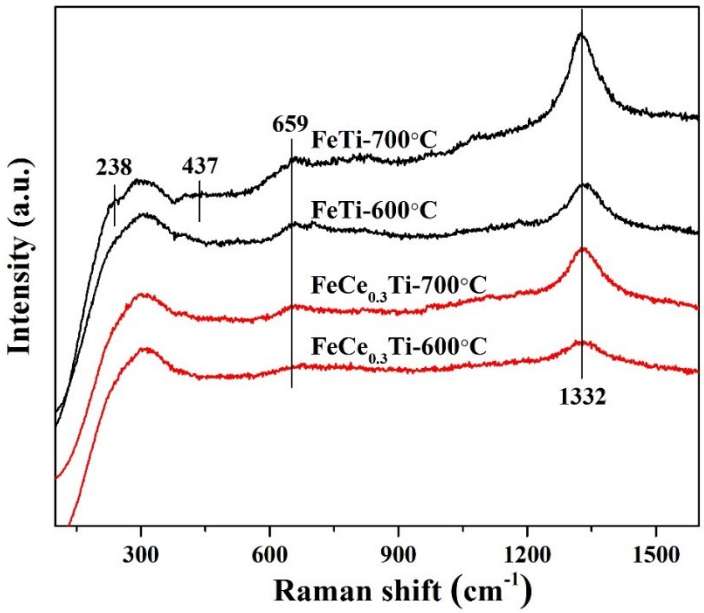

Fig. S5 Raman spectra of FeTi and $FeCe_{0.3}Ti$ catalysts calcined at 600 °C and 700 °C, respectively.

Table S2 XRF results of FeTi and $FeCe_aTi$ catalysts calcined at 500 °C.

	Fe (Wt %)	Ti (Wt %)	Ce (Wt %)
FeTi	35.92	28.60	-
$FeCe_{0.1}Ti$	32.34	25.87	7.82
$FeCe_{0.3}Ti$	26.42	21.30	19.55
$FeCe_{0.5}Ti$	22.99	18.58	27.10
$FeCe_{1.0}Ti$	17.60	14.02	39.21

Table S3 Atom ratios in near-surface region of FeTi and $FeCe_aTi$ catalysts calcined at 500 °C from XPS.

	Fe 2p (%)	Ti 2p (%)	Ce 3d (%)	O 1s (%)
FeTi	30.60	3.85	-	50.23
$FeCe_{0.1}Ti$	30.68	3.60	0.51	49.34
$FeCe_{0.3}Ti$	29.62	2.92	0.86	49.68
$FeCe_{0.5}Ti$	26.60	2.00	1.79	50.50
$FeCe_{1.0}Ti$	23.68	1.53	4.11	51.49

Table S4 XPS binding energies of individual peaks of the Ce 3d spectra for $FeCe_aTi$ catalysts calcined at 500 °C.

	Ce^{4+}						**Ce^{3+}**	
	v	v_2	v_3	u	u_2	u_3	v_1	u_1
$FeCe_{0.1}Ti$	882.6	890.0	898.5	901.2	907.2	915.0	885.0	903.0
$FeCe_{0.3}Ti$	882.6	890.0	898.5	901.0	907.2	916.8	885.7	904.0
$FeCe_{0.5}Ti$	882.6	889.0	898.5	901.2	907.1	916.9	885.0	903.0
$FeCe_{1.0}Ti$	882.6	888.7	898.5	901.2	907.2	916.9	885.0	903.0

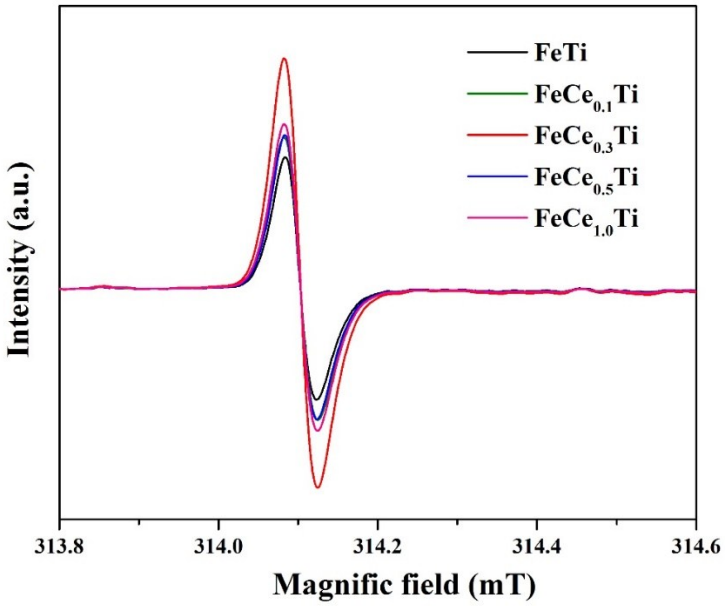

Fig. S6 EPR spectra of FeTi and $FeCe_aTi$ catalysts calcined at 500 °C.