Supporting Information for

Promotional Effect of Ti Doping on the Ketonization of Acetic Acid over CeO_2 Catalyst

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Results

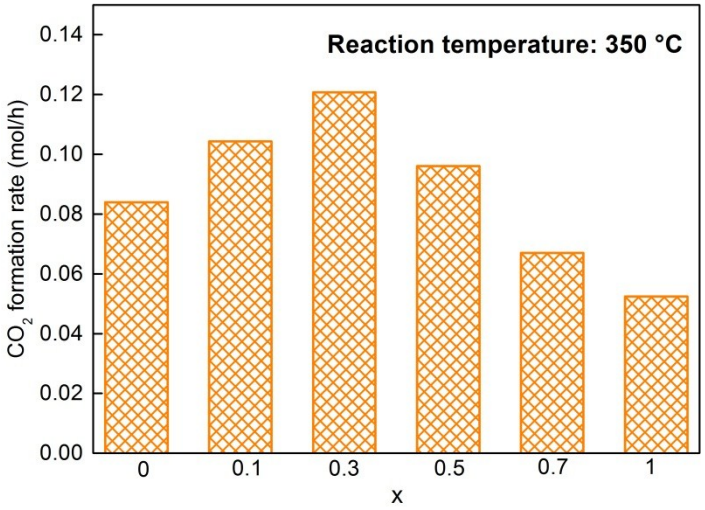

Fig.S1. CO_2 formation rate in the ketonization of acetic acid of $Ce_{1-x}Ti_xO_{2-\delta}$ catalysts at 350 °C.

Table S1 Ketonization activity of acetic acid into acetone over different catalysts.

Entry	Catalyst	Conv./ %	Yield/ %	Select. /%	Reaction condition	Ref.
1	CeO_2	51	51		350°C, WHSV=5.6 h^{-1}	[1]
2	Pr_6O_{11}	80	80		350°C, WHSV=5.6 h^{-1}	[1]
3	ZnO-Al_2O_3 (3:1)[a]	89			350°C, WHSV=0.57 h^{-1}	[2]
4	Zn-Cr (10:1)	86		100	350°C,W/F=4 h·g·mol^{-1}	[3]
5	CeO_2-ZrO_2	95			450°C, WHSV=~146 h^{-1}	[4]
6	CeO_2-Mn_2O_3	72			450°C, WHSV=~146 h^{-1}	[4]

7	$Ce_{0.7}Ti_{0.3}O_{2-\delta}$	100	98	98	350°C, WHSV=6.3 h^{-1}	This work

[a] layered double hydroxides

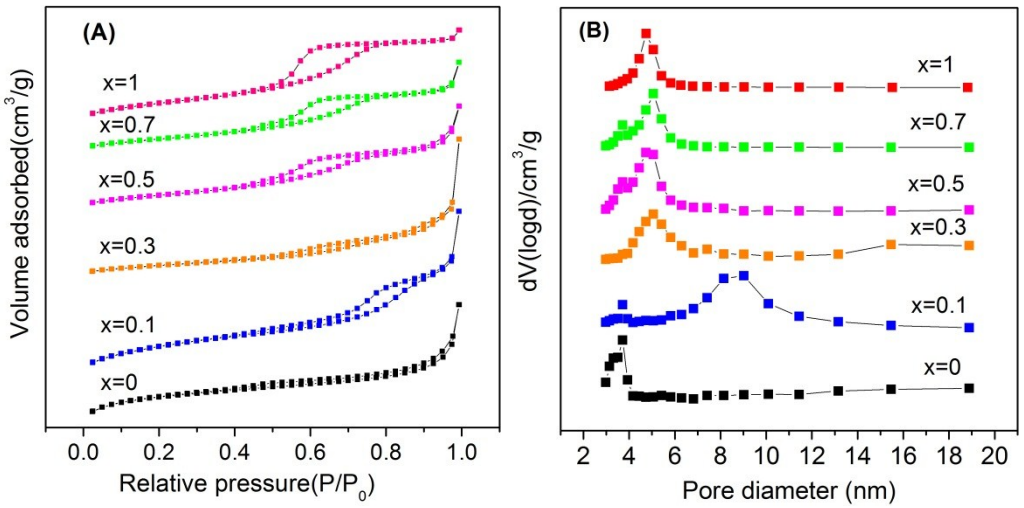

Fig.S2. N_2 adsorption-desorption isotherms (A) and pore size distributions (B) of $Ce_{1-x}Ti_xO_{2-\delta}$ catalysts.

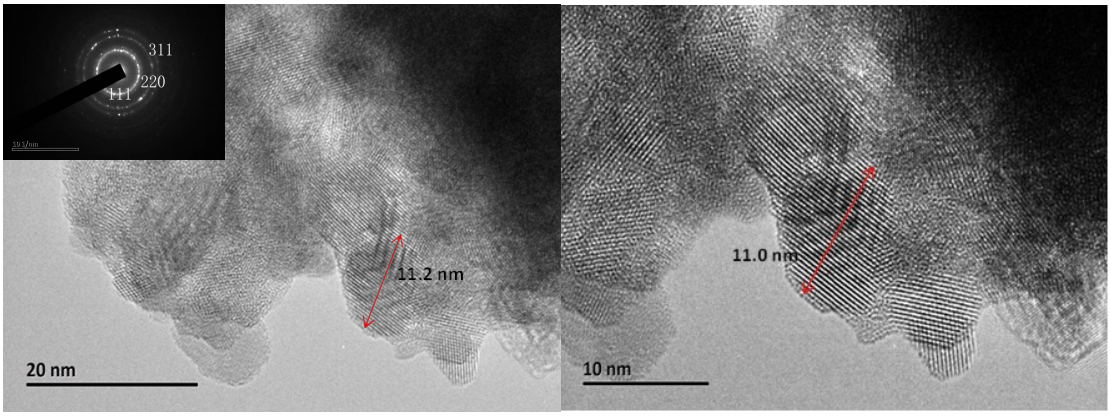

Fig.S3. TEM micrographs of the $Ce_{0.7}Ti_{0.3}O_{2-\delta}$ sample.

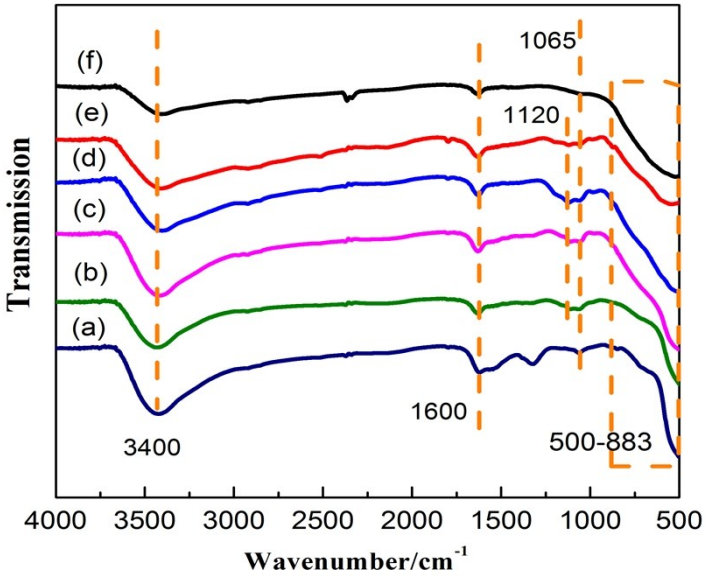

Figure S4. FTIR spectra of $Ce_{1-x}Ti_xO_{2-\delta}$ catalysts at (a) x=0, (b) x=0.1, (c) x=0.3, (d) x=0.5, (e) x=0.7, and (f) x=1.

Table S2 Hydrogen Consumption Estimated from Temperature-Programmed Reduction

x	H_2 consumption(mmol/g)[a]	Peak value
0	0.183	504.4
0.1	0.53854	507.7
0.3	0.62496	510.3
0.5	0.86899	553.1
0.7	0.77552	589.6
1	0.06781	--

[a] The H_2 consumption was calculated from the integration of TPR area.

Table S3 Acid sites distribution based on NH_3-TPD data and basic sites distribution based on CO_2-TPD data for $Ce_{1-x}Ti_xO_{2-\delta}$ catalysts.

x	Acid sites/μmol·m^{-2}			Basic sites/μmol·m^{-2}		
	Weak (323-523 K)	Strong (523-773 K)	Total	Weak (323-523 K)	Strong (523-773 K)	Total
0	1.87	0.24	2.11	2.82	0.07	2.89
0.1	2.81	0.39	3.21	2.70	0.21	2.91
0.3	3.67	0.73	4.40	3.57	0.51	4.08
0.5	2.88	2.17	5.05	2.25	0.75	3.00
0.7	2.79	2.18	4.98	2.26	1.46	3.72
1	2.14	3.91	6.05	1.72	3.36	5.09

Table S4 Ce3d XPS results of $Ce_xTi_{1-x}O_{2-\delta}$ catalysts

Catalyst	BE, eV								Binding energy , eV		
	v	v'	v''	v'''	u	u'	u''	u'''	O_α	O_β	O_γ
CeO_2	882.7	885.2	888.8	898.2	901.2	903.7	907.3	916.7	529.1	531.2	--
$Ce_{0.9}Ti_{0.1}O_{2-\delta}$	882.4	885.0	889.2	898.9	900.9	903.5	907.7	917.4	529.2	531.2	--
$Ce_{0.7}Ti_{0.3}O_{2-\delta}$	882.8	885.8	888.9	898.2	901.3	904.3	907.4	917.6	529.3	531.3	--
$Ce_{0.5}Ti_{0.5}O_{2-\delta}$	882.8	885.6	889.5	899.2	901.3	904.1	908.0	917.7	529.4	531.3	533.4
$Ce_{0.3}Ti_{0.7}O_{2-\delta}$	883.4	886.0	890.3	900.4	901.9	904.5	908.8	918.9	529.7	531.5	533.5

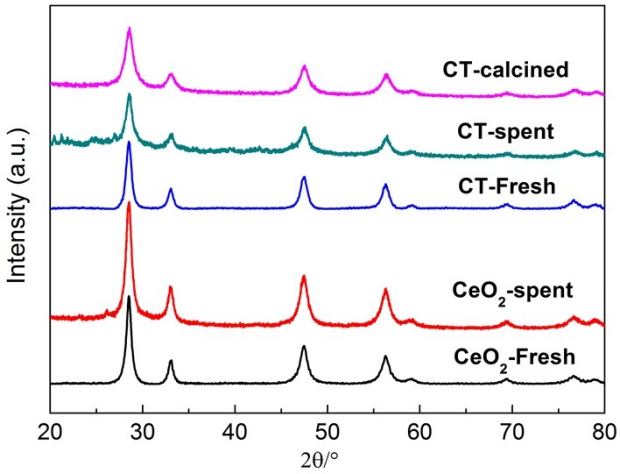

Figure S5. XRD results of postreaction catalysts.

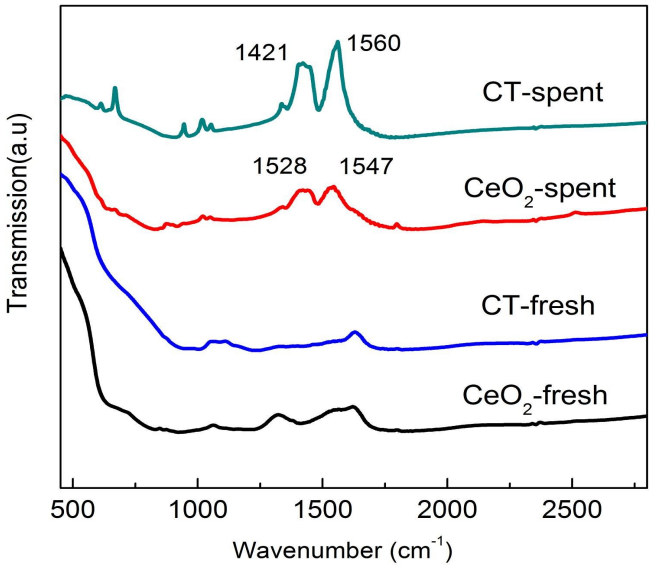

Figure S6. FTIR results of postreaction catalysts.

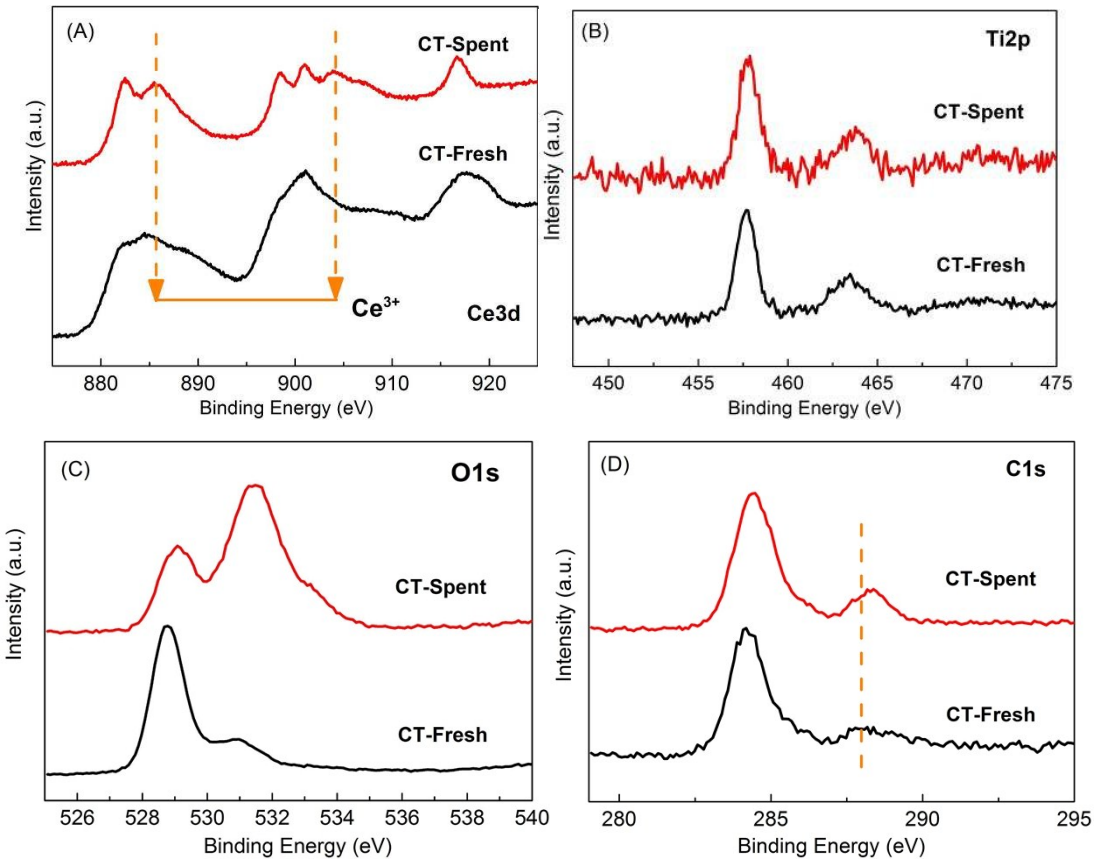

Figure S7. XPS results of the spent and fresh $Ce_{0.7}Ti_{0.3}O_{2-\delta}$ catalyst.

References:

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