Electronic Supplementary Material (ESI) for RSC Advances.
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Supporting information

Table 1 Metatitanic acid grain calculations in different titanium concentrations and temperatures

Titanium concentration (mol□L^{-1})	Hydrolysis temperature (ºC)	Hydrolysis ratio (%)	D(50) (μm)	Grain size (nm)			n ($\times10^3$)	m ($\times10^8$)	n_i ($\times10^3$)	n_s ($\times10^3$)	m_i ($\times10^8$)	m_s ($\times10^6$)
				A	B	C						
1.62	120	64.57	4.158	4.202	4.202	0.4830	0.2522	44.10	0.1171	0.1351	44.04	9.428
	130	96.69	5.622	6.187	6.187	0.8739	0.9864	27.80	0.6755	0.3110	27.75	6.550
	140	96.36	3.701	7.852	7.852	4.99	9.140	0.8620	8.294	0.8468	0.8572	0.4812
	150	96.69	4.308	9.347	9.347	5.857	15.17	0.8180	13.97	1.195	0.8136	0.4654
1.75	120	73.17	2.314	4.544	4.544	0.639	0.3896	4.910	0.2251	0.1645	4.893	2.063
	130	95.12	3.314	5.686	5.686	0.520	0.4965	11.30	0.2523	0.2442	11.30	4.067
	140	96.34	2.802	9.345	9.345	6.411	16.57	0.2060	15.32	1.251	0.2039	0.1838
	150	93.9	3.591	9.858	9.858	6.133	17.61	0.4070	16.29	1.323	0.4039	0.2921
1.85	120	72.25	2.147	5.486	5.486	0.411	0.3649	4.190	0.1437	221.183	4.170	0.1183
	130	94.22	2.459	6.633	6.633	3.803	4.934	0.4650	4.366	567.662	0.4622	0.1763
	140	96.11	2.036	7.608	7.608	4.095	6.981	0.1860	6.254	727.300	1.847	0.3223
	150	96.53	2.392	10.340	10.340	6.389	20.21	0.1050	18.76	1453.864	0.1037	2.219
1.97	120	37.23	1.908	5.307	5.307	0.373	0.3097	3.460	0.1051	204.597	3.439	0.1553
	130	83.42	2.077	5.982	5.982	2.892	3.056	0.4530	2.631	425.053	0.4502	0.1366
	140	97.28	2.081	8.632	8.632	4.927	10.84	0.1290	9.874	968.696	0.1272	0.3235
	150	97.83	2.312	9.622	9.622	4.633	12.70	0.1510	11.580	1117.694	0.1493	1.988

Table 2 The calculation process results

Titanium concentration (mol□L^{-1})	Hydrolysis temperature (ºC)	Cl^- concentration	SO_4^{2-} concentration	(-)ln(1-η)	$2\ln(n_H+2\eta)$	$\ln(n_{Cl}-1+\eta)$	$\ln(n_S-1+\eta)$	2ln(nw)	$-5\ln(n_H+nw+n_{cl}+ns+3\eta+1)$
1.62	110	1	0.7755	0.1120	2.766	0.1007	-0.1262	5.792	-16.09
	120	1	0.7755	1.0383	3.245	0.4982	0.3515	5.792	-16.40
	130	1	0.7755	3.408	3.484	0.6765	0.5552	5.792	-16.58
	140	1	0.7755	3.313	3.482	0.6748	0.5533	5.792	-16.58
	150	1	0.7755	3.408	3.484	0.6765	0.5552	5.792	-16.58
1.75	110	1	0.4930	0.1232	2.630	0.1097	-0.4962	5.509	-15.47
	120	1	0.4930	1.316	3.201	0.5491	0.2027	5.509	-15.87
	130	1	0.4930	3.020	3.371	0.6684	0.3675	5.509	-16.007
	140	1	0.4930	3.308	3.380	0.6747	0.3759	5.509	-16.017
	150	1	0.4930	2.797	3.362	0.6622	0.3590	5.509	-15.60
1.85	120	1	0.3112	1.282	3.119	0.5438	0.0332	5.308	-15.46

	130	1	0.3112	2.851	3.296	0.6638	0.2259	5.308	-15.606
	140	1	0.3112	3.247	3.310	0.6735	0.2409	5.308	-15.62
	150	1	0.3112	3.361	3.313	0.6756	0.2442	5.308	-15.62
	110	1	0.0983	0.0792	2.358	0.0733	-1.746	5.100	-14.52
1.97	120	1	0.0983	0.4657	2.692	0.3165	-0.7537	5.100	-14.75
	130	1	0.0983	1.797	3.123	0.6067	-0.0699	5.100	-15.10
	140	1	0.0983	3.605	3.236	0.6795	0.0687	5.100	-15.20
	150	1	0.0983	3.830	3.241	0.6822	0.0738	5.100	-15.21

Table 1 and 2 were the experimental and calculation process in this hydrolysis process.

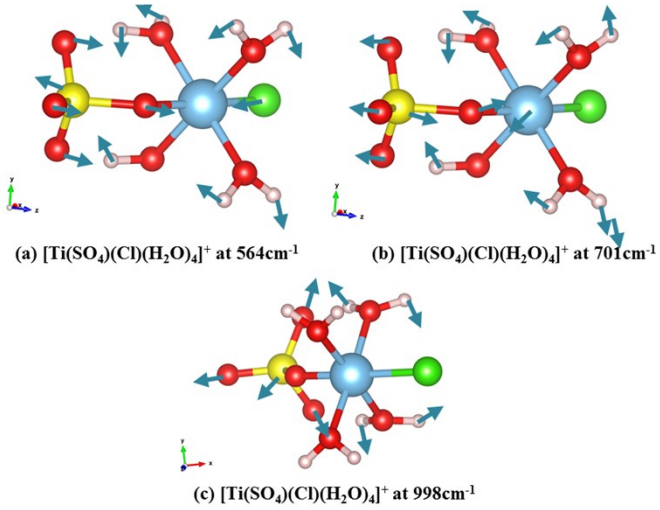

Fig.1 The vibration analysis of $[Ti(SO_4)Cl(H_2O)_4]^+$ in different Raman shifts

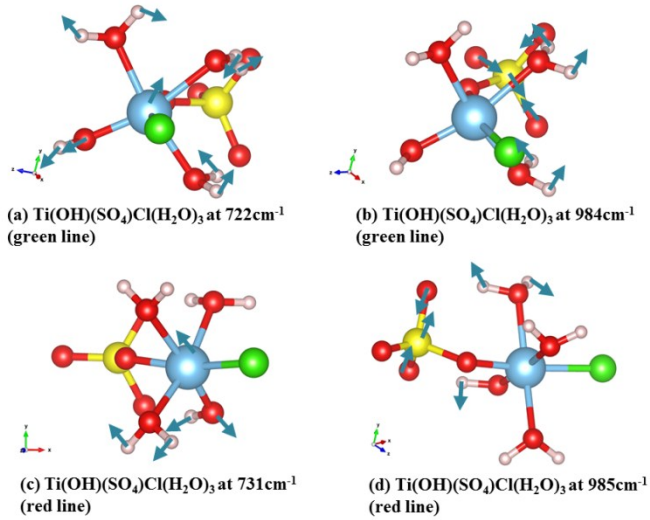

Fig.2 The vibration analysis of $Ti(OH)(SO_4)Cl(H_2O)_3$ in different Raman shifts