

SUPPLEMENTARY INFORMATION

Synthesis and characterization of hierarchical titanium-containing silicas by using different size templates

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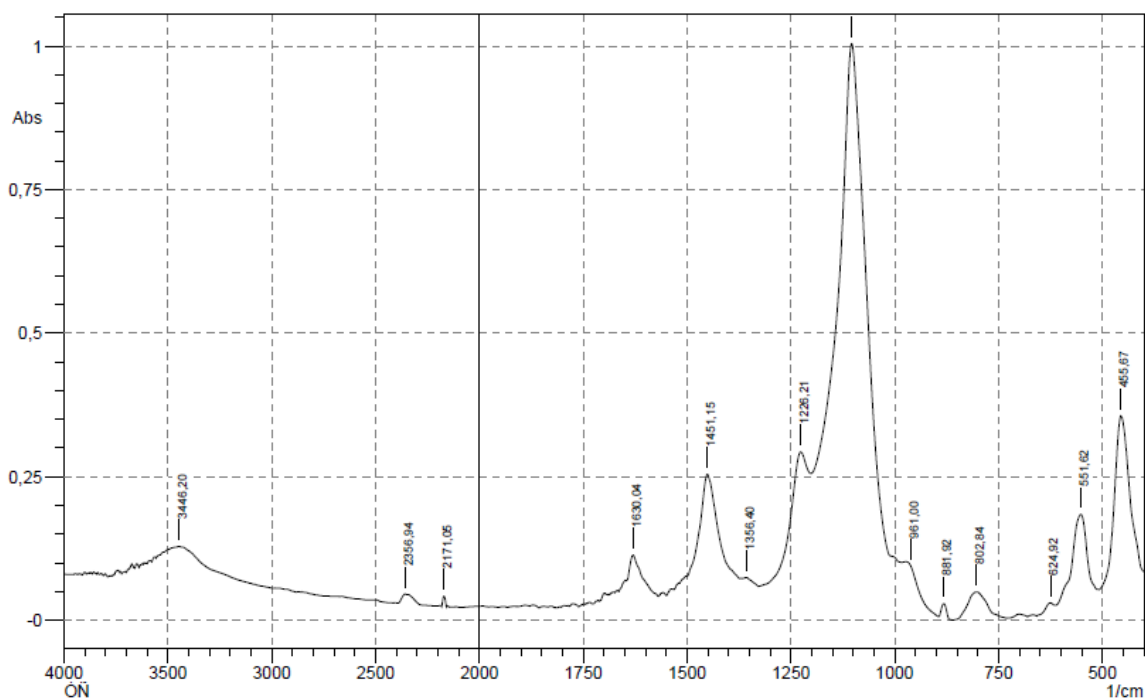
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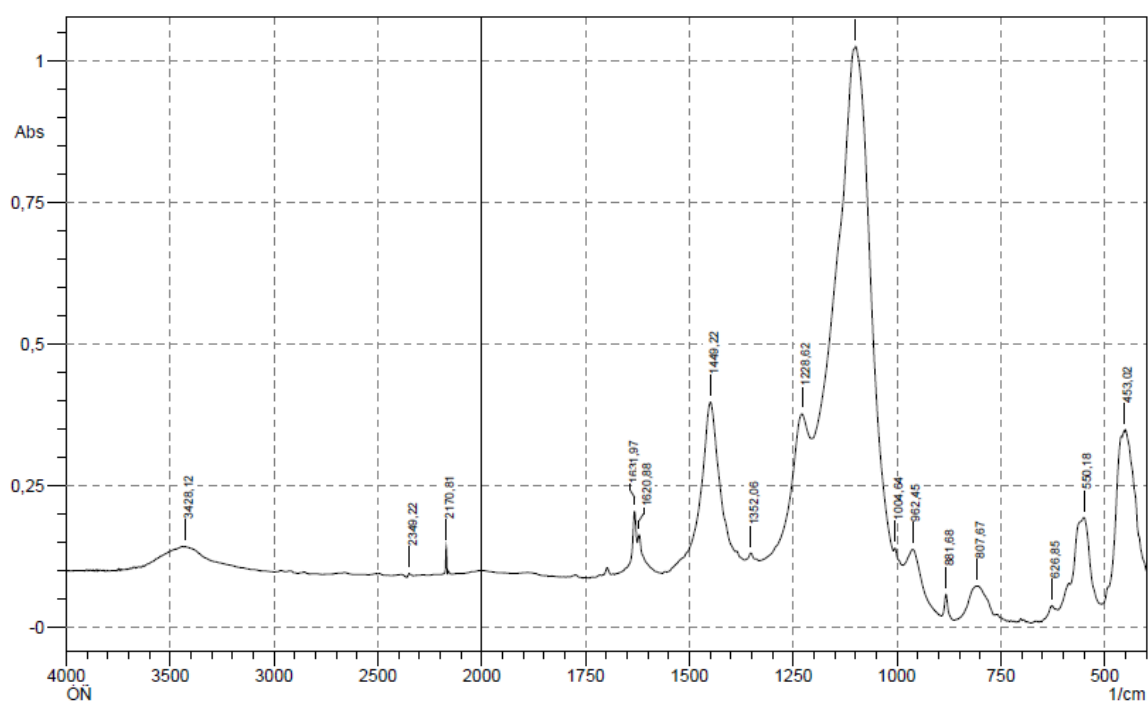
Table S1. XRD data for samples

Sample name	Crystallinity (%)	Cell param.			Crystal system
		a	b	c	
TS-1	90	20.13690	19.94550	13.42030	Orthorhombic - S-Q 100.0 %
TMAB (a)	44	20.13690	19.94550	13.42030	Orthorhombic - S-Q 100.0 %
TEAB (b)	86	20.13690	19.94550	13.42030	Orthorhombic - S-Q 59.1%
		20.11717	20.11717	13.41100	Tetragonal - S-Q 40.9 %
DTMAB (c)	78	20.13690	19.94550	13.42030	Orthorhombic - S-Q 100.0 %
TBAG (d)	88	20.13690	19.94550	13.42030	Orthorhombic - S-Q 100.0 %
CTAB (e)	85	20.13690	19.94550	13.42030	Orthorhombic - S-Q 100.0 %
TBDAB (f)	12	20.13690	19.94550	13.42030	Orthorhombic - S-Q 100.0 %
DDAC (g)	0,8	20.13690	19.94550	13.42030	Orthorhombic - S-Q 100.0 %



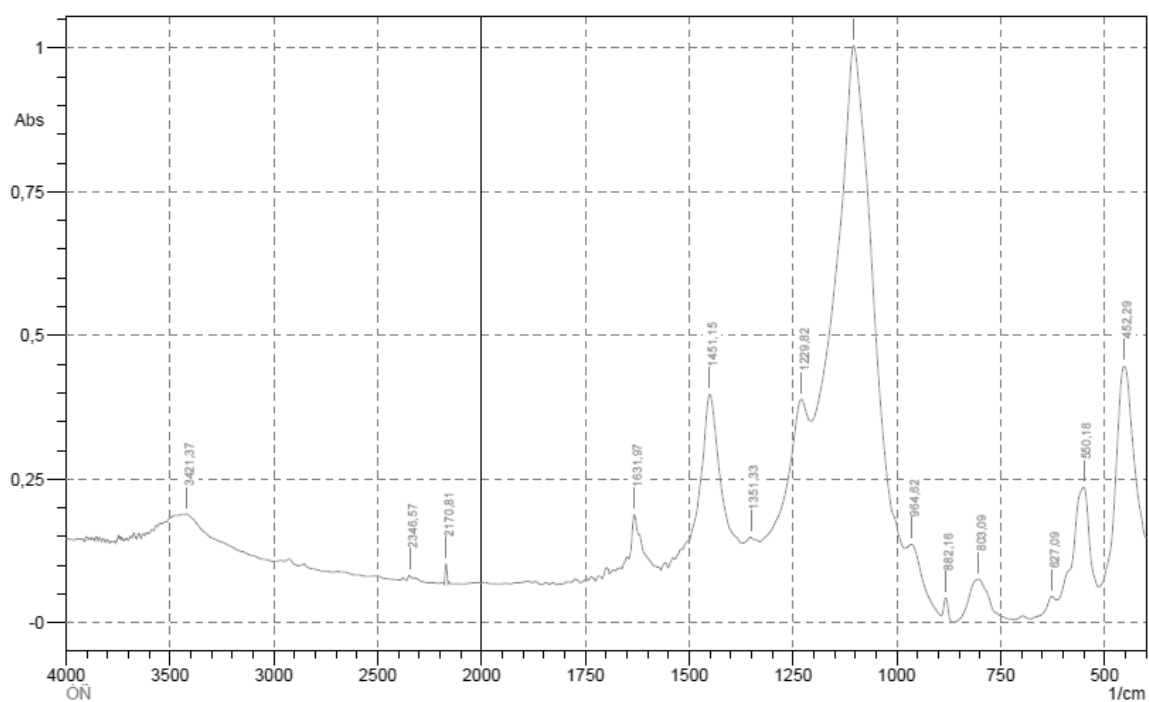
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	455,67	0,3564	0,2877	507,74	400,22	19,3609	11,9138
2	551,62	0,1844	0,1411	611,9	513,29	9,4935	5,5345
3	624,92	0,0302	0,0089	657,71	613,34	0,8998	0,1518
4	802,84	0,0493	0,0002	803,09	730,76	1,5706	-0,3566
5	881,92	0,029	0,0246	894,22	860,71	0,4507	0,3308
6	961	0,0942	0,0208	983,18	939,79	3,7417	0,5277
7	1103,49	1,0043	0,8184	1201,85	983,42	97,5366	58,6061
8	1226,21	0,2934	0,0758	1327,71	1201,85	19,5451	-0,2545
9	1356,4	0,0744	0,0006	1357,36	1328,67	1,9318	0,0193
10	1451,15	0,2544	0,1724	1499,12	1393,28	16,288	7,563
11	1630,04	0,1137	0,0508	1646,67	1569,52	5,7731	1,5193
12	2171,05	0,0421	0,0186	2181,66	2159	0,7901	0,2578
13	2356,94	0,0457	0,0001	2357,42	2353,56	0,1751	0,0001
14	3446,2	0,1291	0,0017	3458,74	3435,59	2,9705	0,0216

Figure S1. IR spectrum of TS-1



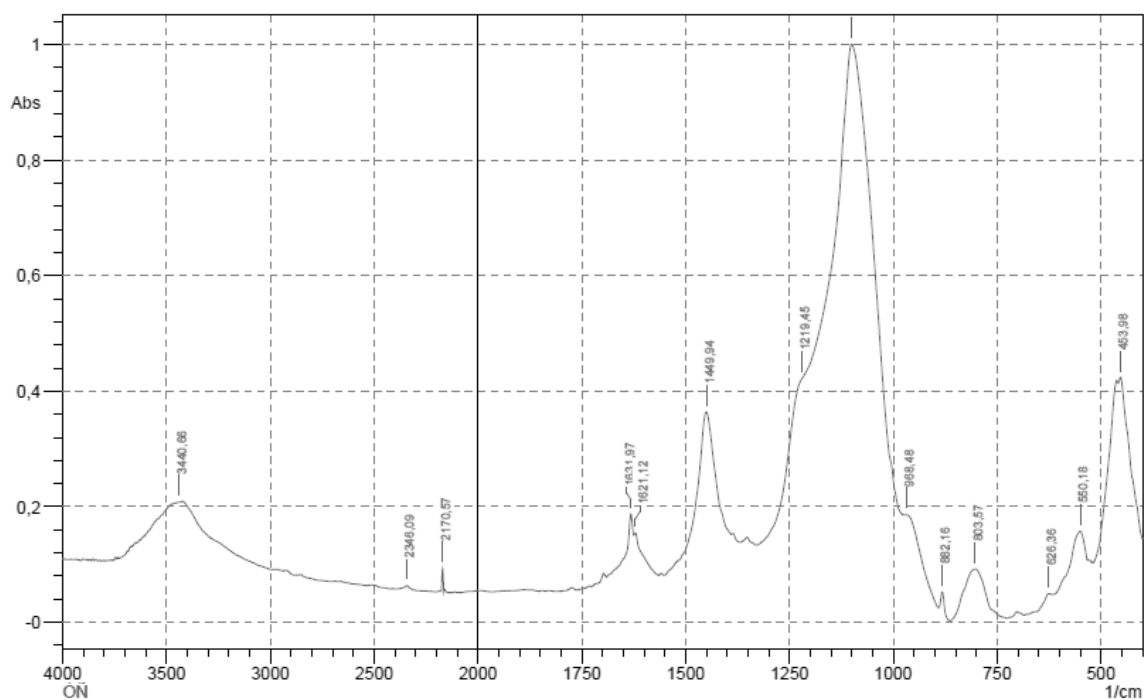
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	453,02	0,3466	0,0012	457,36	452,53	1,6483	0,0033
2	550,18	0,1934	0,0018	582,97	549,69	4,9107	0,4329
3	626,85	0,0378	0,011	651,68	619,37	0,7966	0,125
4	807,67	0,0727	0	808,87	807,42	0,105	0
5	881,68	0,058	0,0409	893,5	861,67	0,8836	0,3716
6	962,45	0,137	0,0505	986,08	893,5	7,3061	1,3257
7	1004,64	0,1396	0,0091	1008,5	986,08	2,7566	0,0175
8	1099,39	1,0248	0,0452	1103,73	1008,5	52,6777	-2,3115
9	1228,62	0,3761	0,0823	1332,05	1205,71	28,1737	-0,2579
10	1352,06	0,131	0,0113	1367,25	1342,41	3,0738	0,1055
11	1449,22	0,3969	0,269	1517,21	1389,67	28,6334	12,3619
12	1620,88	0,1633	0,0182	1625,22	1571,69	6,2278	-0,3352
13	1631,97	0,204	0,0662	1651,01	1625,22	3,6998	0,4192
14	2170,81	0,1419	0,0478	2197,09	2165,27	3,2733	0,2934
15	2349,22	0,0948	0,0036	2360,55	2343,2	1,5993	0,031
16	3428,12	0,1421	0	3428,6	3424,99	0,5137	0,0001

Figure S2. IR spectrum of sample H-TS with TBAG



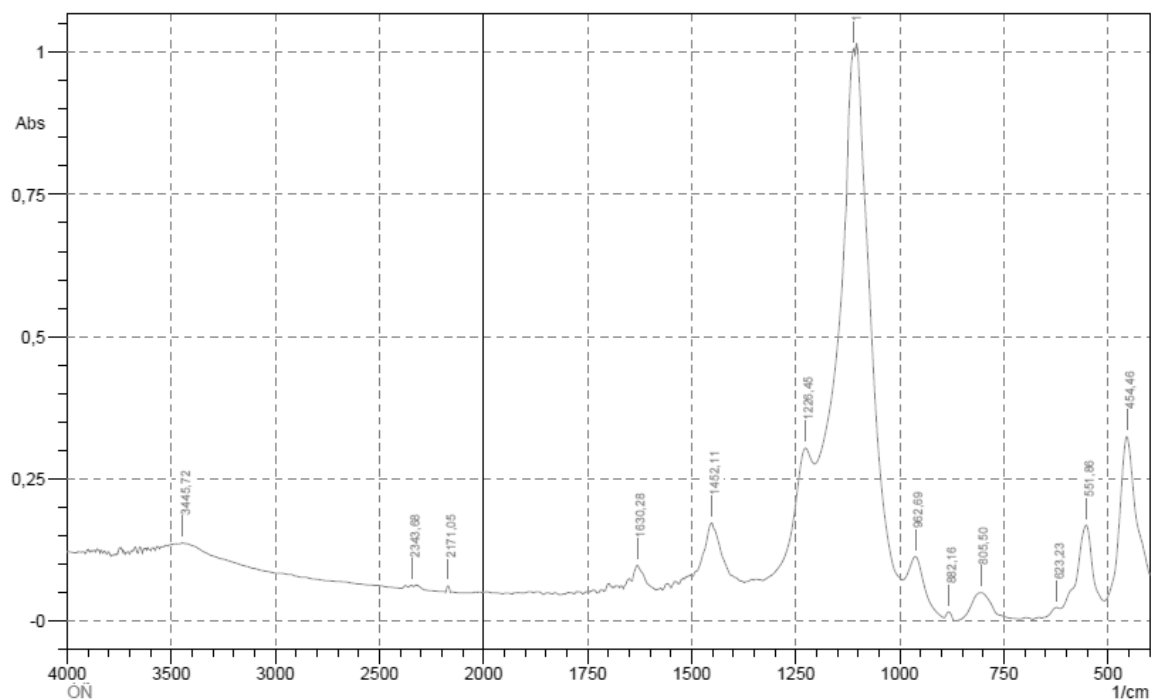
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	452,29	0,4464	0,0103	513,29	450,85	13,0463	-2,7971
2	550,18	0,2359	0,1816	613,34	513,29	12,5935	7,4613
3	627,09	0,0462	0,0137	661,08	615,51	1,3153	0,1577
4	803,09	0,0761	0,0727	863,36	728,1	4,4423	3,947
5	882,16	0,043	0,0347	893,01	863,36	0,5791	0,3803
6	964,62	0,1366	0,027	979,57	893,01	6,6331	0,471
7	1103,97	1,0043	0,7535	1206,92	979,57	121,3257	66,6788
8	1229,82	0,3891	0,0772	1330,12	1206,92	31,0114	0,7116
9	1351,33	0,1489	0,0061	1370,14	1343,14	3,8995	0,0742
10	1451,15	0,3974	0,2509	1499,85	1390,15	27,2144	11,0894
11	1631,97	0,1878	0,0735	1644,5	1607,62	5,5475	1,2795
12	2170,81	0,1021	0,0345	2179,49	2161,65	1,5652	0,3585
13	2346,57	0,0821	0,0001	2346,81	2336,93	0,794	0
14	3421,37	0,1895	0,0002	3432,46	3419,68	2,415	0,0004

Figure S3. IR spectrum of sample H-TS with CTAB



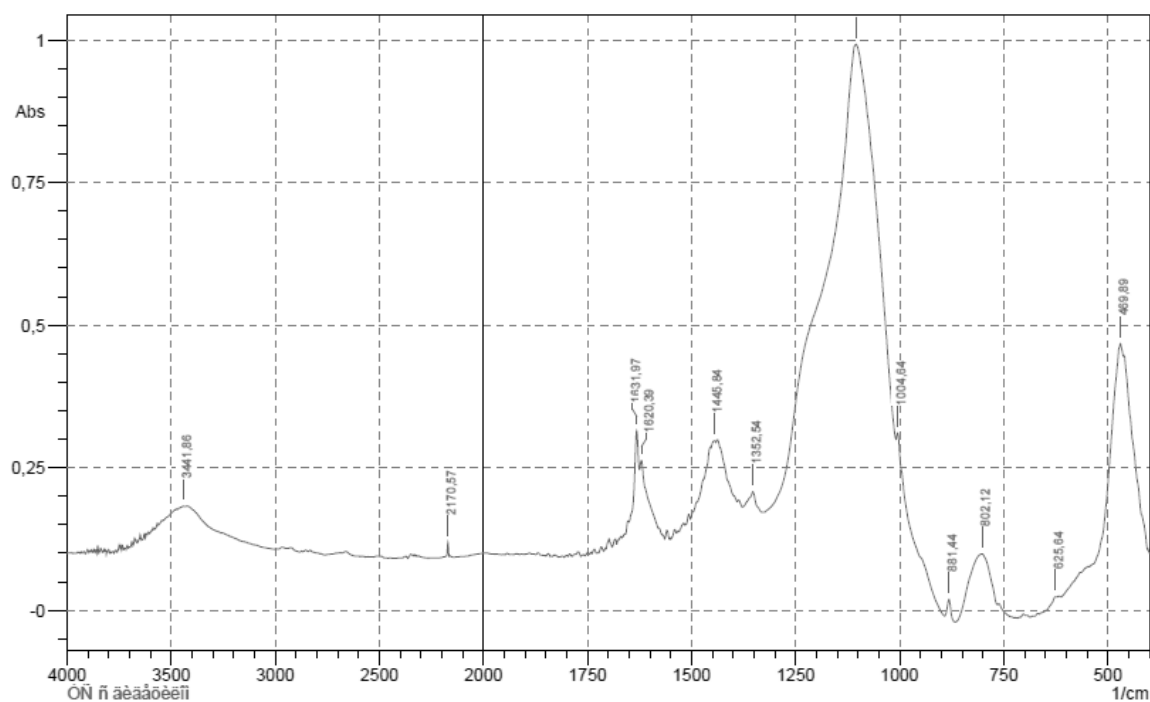
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	453,98	0,4224	0,0013	457,36	453,5	1,6178	0,0036
2	550,18	0,1575	0,0016	586,58	549,45	4,4469	0,0755
3	626,36	0,0495	0,0009	652,88	625,64	0,9038	-0,0211
4	803,57	0,0917	0,0008	861,19	803,09	2,8498	0,1032
5	882,16	0,0522	0,0354	891,57	865,77	0,6699	0,3129
6	968,48	0,1859	0,0015	969,2	891,57	8,3444	0,1648
7	1099,87	1,0009	0,8334	1330,12	975,47	170,6024	113,9934
8	1219,45	0,4223	0,0337	1275,87	1204,51	24,2783	1,7212
9	1449,94	0,3637	0,2382	1548,55	1390,39	30,2013	11,7111
10	1621,12	0,1549	0,0093	1624,98	1570,25	6,1637	-0,2203
11	1631,97	0,1873	0,0452	1681,63	1624,98	6,6144	-0,0066
12	2170,57	0,0929	0,04	2177,08	2164,06	0,9715	0,2825
13	2346,09	0,0628	0,0001	2347,29	2345,85	0,0907	0,0001
14	3440,66	0,208	0,0001	3441,14	3436,56	0,9511	-0,0001

Figure S4. IR spectrum of sample H-TS with TMAB



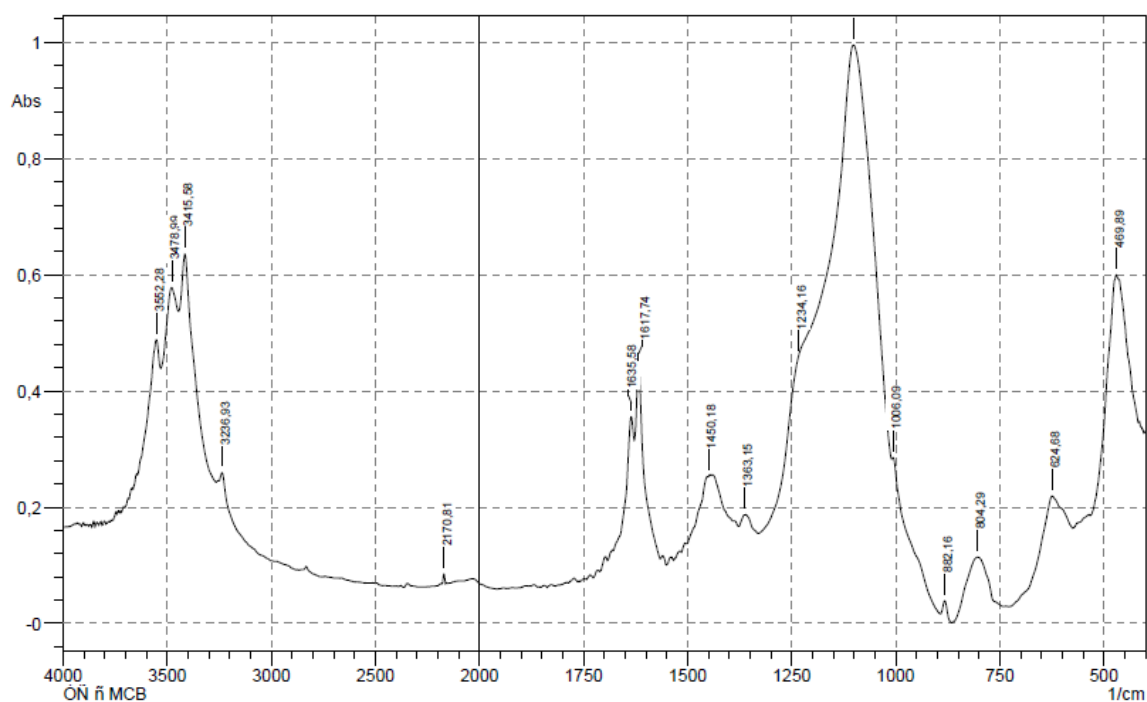
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	454,46	0,324	0,2661	506,54	399,98	17,4345	11,2137
2	551,86	0,1683	0,1388	614,79	508,23	8,3424	5,3283
3	623,23	0,0231	0,0048	657,95	614,79	0,6299	0,0649
4	805,5	0,0495	0,0002	866,01	805,25	1,2779	-0,2265
5	882,16	0,0157	0,0127	893,98	866,01	0,2377	0,165
6	962,69	0,1132	0,0619	993,07	893,98	5,902	2,0923
7	1111,2	1,0053	0,0014	1112,17	1110,72	1,4531	0,0014
8	1226,45	0,3036	0,0636	1328,91	1204,75	21,0755	-0,4381
9	1452,11	0,1721	0,0242	1485,38	1445,12	5,469	0,4471
10	1630,28	0,0973	0,0293	1643,54	1605,21	3,1886	0,62
11	2171,05	0,0615	0,0115	2181,9	2159	1,3034	0,1595
12	2343,68	0,0616	0,0001	2343,92	2339,58	0,2653	0
13	3445,72	0,137	0,0001	3458,98	3445	1,9056	0,0008

Figure S5. IR spectrum of sample H-TS with TEAB



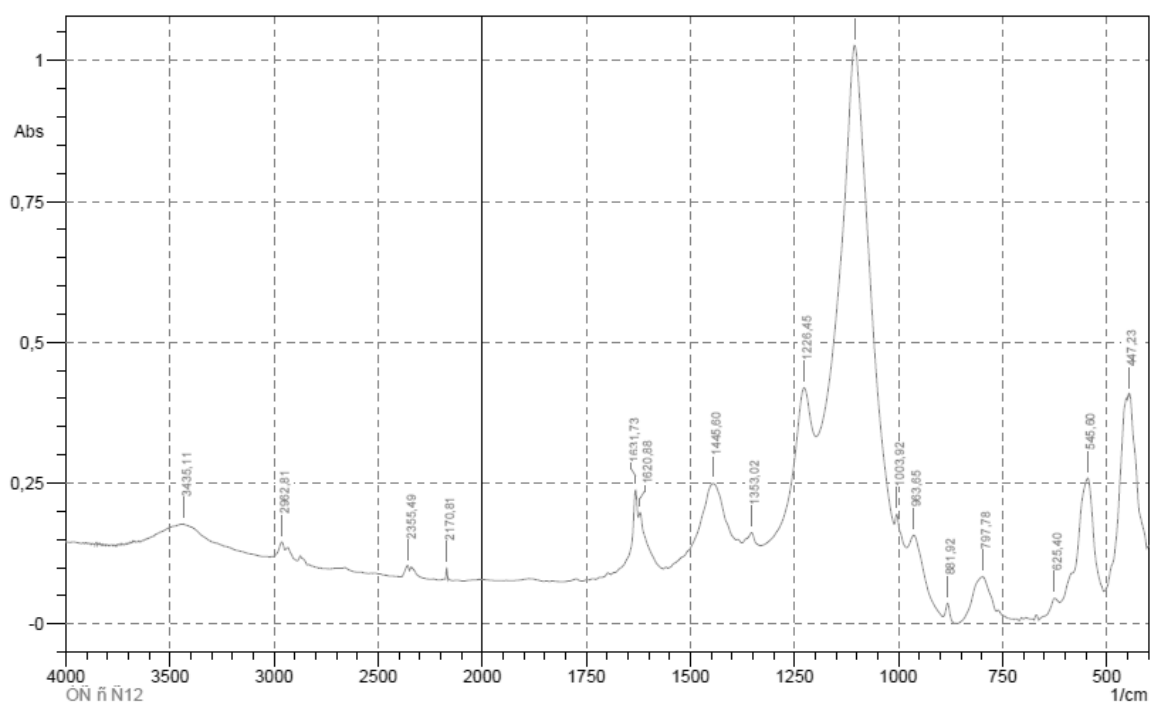
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	469,89	0,4674	0,0564	533,3	463,14	18,1134	-0,3855
2	625,64	0,0236	0,0028	655,29	622,99	0,2787	-0,0323
3	802,12	0,0988	0,1005	866,73	764,51	5,0438	5,626
4	881,44	0,0187	0,0333	891,81	866,73	-0,0856	0,3041
5	1004,64	0,3102	0,0216	1008,98	891,81	12,6928	-4,288
6	1105,66	0,9922	0,002	1327,22	1105,18	108,271	-20,9048
7	1352,54	0,2075	0,0316	1378,34	1332,05	8,7572	0,5889
8	1445,84	0,2973	0,0044	1452,59	1443,19	2,7663	0,0334
9	1620,39	0,2626	0,0274	1625,22	1580,61	8,8087	0,1119
10	1631,97	0,3149	0,0931	1650,29	1625,22	5,6752	0,6403
11	2170,57	0,1187	0,0251	2187,69	2165,03	2,2759	0,1559
12	3441,86	0,1821	0,0002	3442,83	3440,17	0,4827	0,0002

Figure S6. IR spectrum of sample H-TS with DDAC



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	469,89	0,599582	0,037545	529,2	465,07	24,736401	-0,288755
2	624,68	0,219325	0,049629	727,62	603,7	13,906475	-0,167312
3	804,29	0,114183	0,000922	864,81	803,81	3,525332	-0,002343
4	882,16	0,039224	0,028275	892,77	864,81	0,557524	0,302623
5	1006,09	0,285373	0,010634	1009,7	892,77	14,486986	-3,034311
6	1101,32	0,994869	0,748463	1329,88	1009,7	172,035535	101,893092
7	1234,16	0,457837	0,06459	1281,9	1201,37	32,015231	2,553615
8	1363,15	0,186791	0,001654	1377,13	1361,94	2,708909	0,02267
9	1450,18	0,252819	0,000153	1450,91	1449,7	0,30467	9,5e-005
10	1617,74	0,440474	0,158999	1628,11	1565,43	15,000607	1,633701
11	1635,58	0,355622	0,069028	1677,53	1628,11	10,938544	0,034743
12	2170,81	0,08515	0,016738	2178,05	2162,86	1,183626	0,144752
13	3236,93	0,259117	0,023168	3251,64	3049,12	33,772506	-2,945497
14	3415,58	0,63517	0,147641	3445,72	3266,59	73,905541	4,028642
15	3478,99	0,578027	0,000646	3530,83	3478,75	26,452089	-0,032841
16	3552,28	0,488059	0,083786	3643,9	3530,83	42,878061	3,609577

Figure S7. IR spectrum of sample H-TS with TBDAB



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	447,23	0,4071	0,0041	449,88	446,27	1,4609	0,0087
2	545,6	0,2589	0,1839	580,8	506,78	11,6922	6,1988
3	625,4	0,0457	0,0162	649,27	612,38	1,1721	0,2188
4	797,78	0,0836	0,0686	857,57	764,99	4,1545	3,0659
5	881,92	0,0367	0,0284	893,01	864,56	0,4833	0,2837
6	963,65	0,1571	0,0454	980,29	893,01	7,5043	1,0505
7	1003,92	0,1948	0,0266	1010,19	980,29	4,8681	0,2041
8	1105,9	1,0266	0,0064	1197,27	1105,18	54,3683	-8,178
9	1226,45	0,419	0,1286	1331,08	1197,27	34,0017	2,4492
10	1353,02	0,1621	0,0208	1375,93	1332,53	6,5012	0,3664
11	1445,6	0,2492	0,1132	1518,41	1389,91	23,6402	6,4165
12	1620,88	0,1978	0,016	1625,22	1570,49	7,5728	-0,3093
13	1631,73	0,2377	0,0601	1681,15	1625,22	7,4696	-0,3643
14	2170,81	0,0988	0,02	2177,32	2164,3	1,1628	0,1373
15	2355,49	0,1014	0,0004	2355,73	2351,63	0,4056	0,0012
16	2962,81	0,1453	0,0173	3005,48	2947,14	7,6928	0,3888
17	3435,11	0,1769	0	3435,35	3427,64	1,3612	0,0004

Figure S8. IR spectrum of sample H-TS with DTBAB

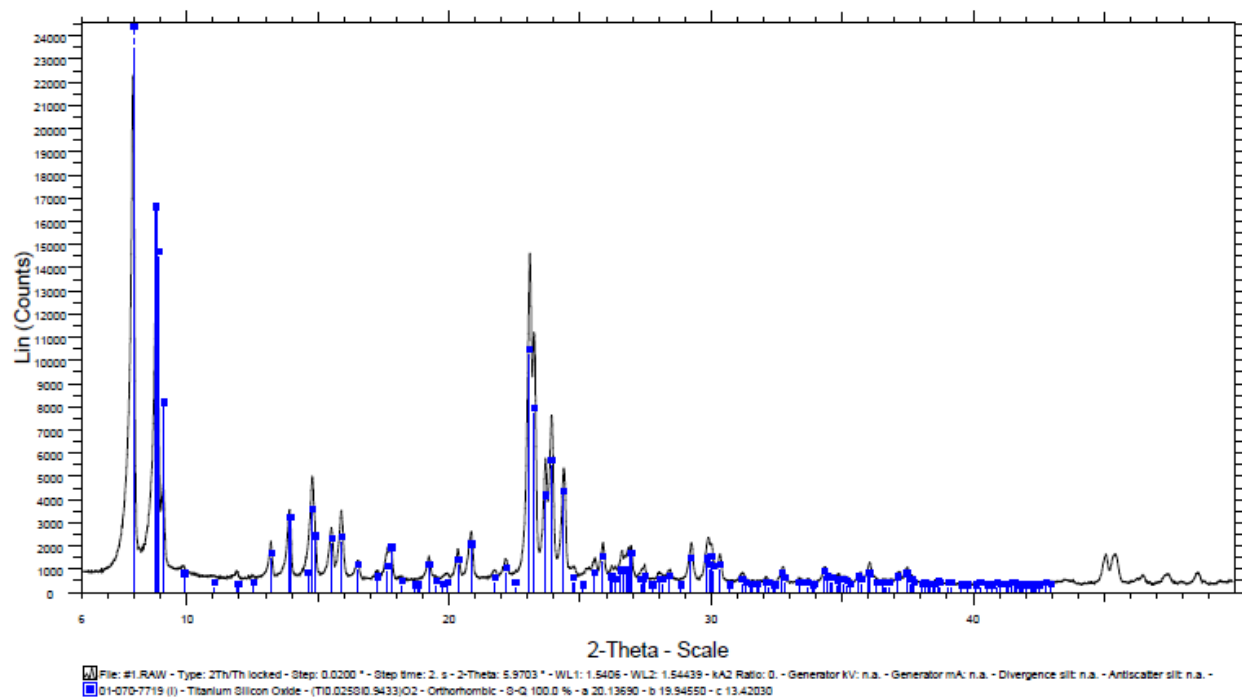


Figure S9. XRD pattern of TS-1

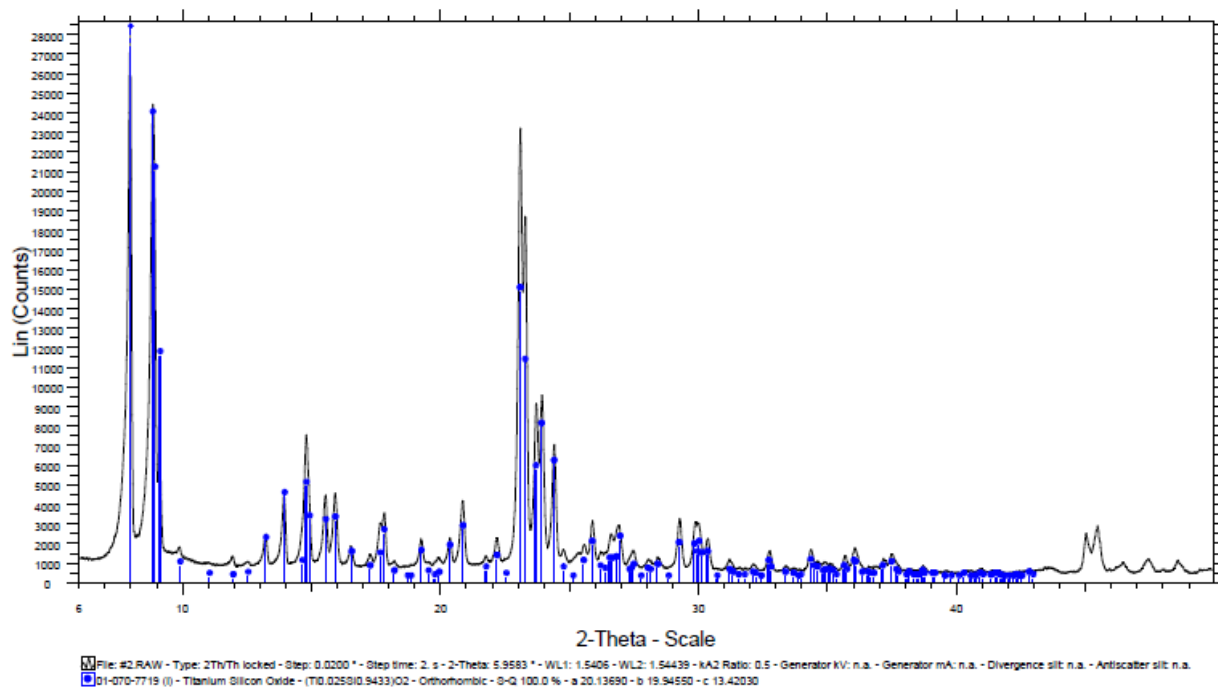


Figure S10. XRD pattern of sample H-TS with TBAG

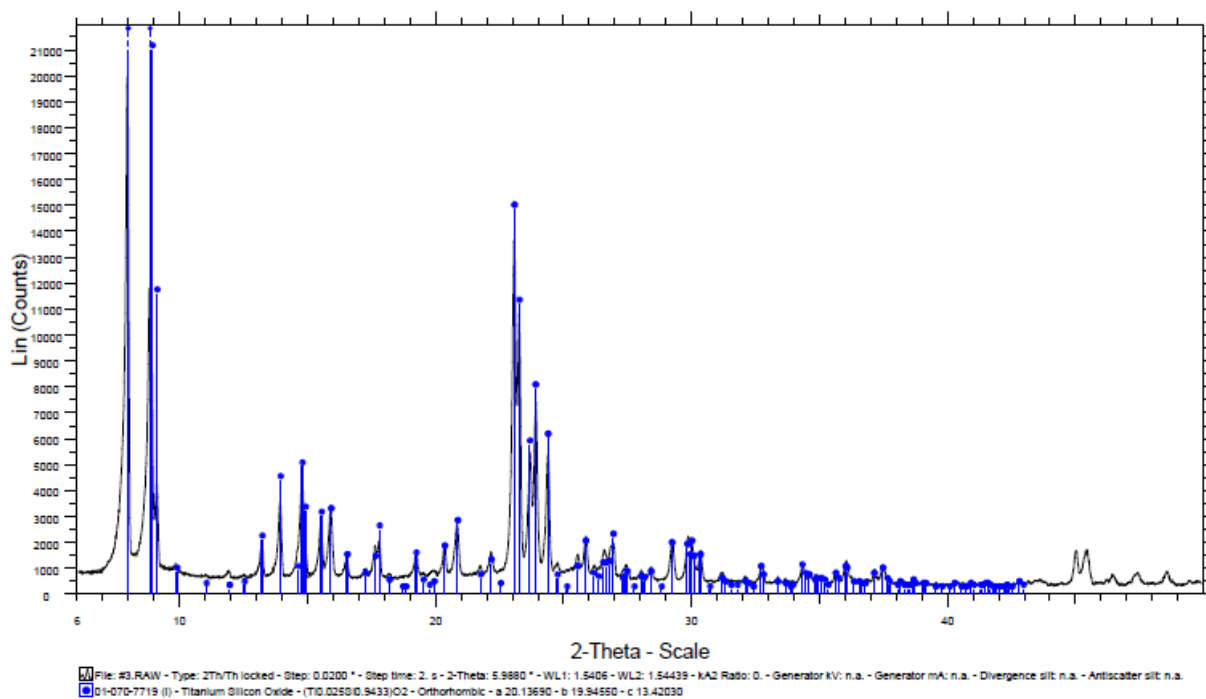


Figure S11. XRD pattern of sample H-TS with CTAB

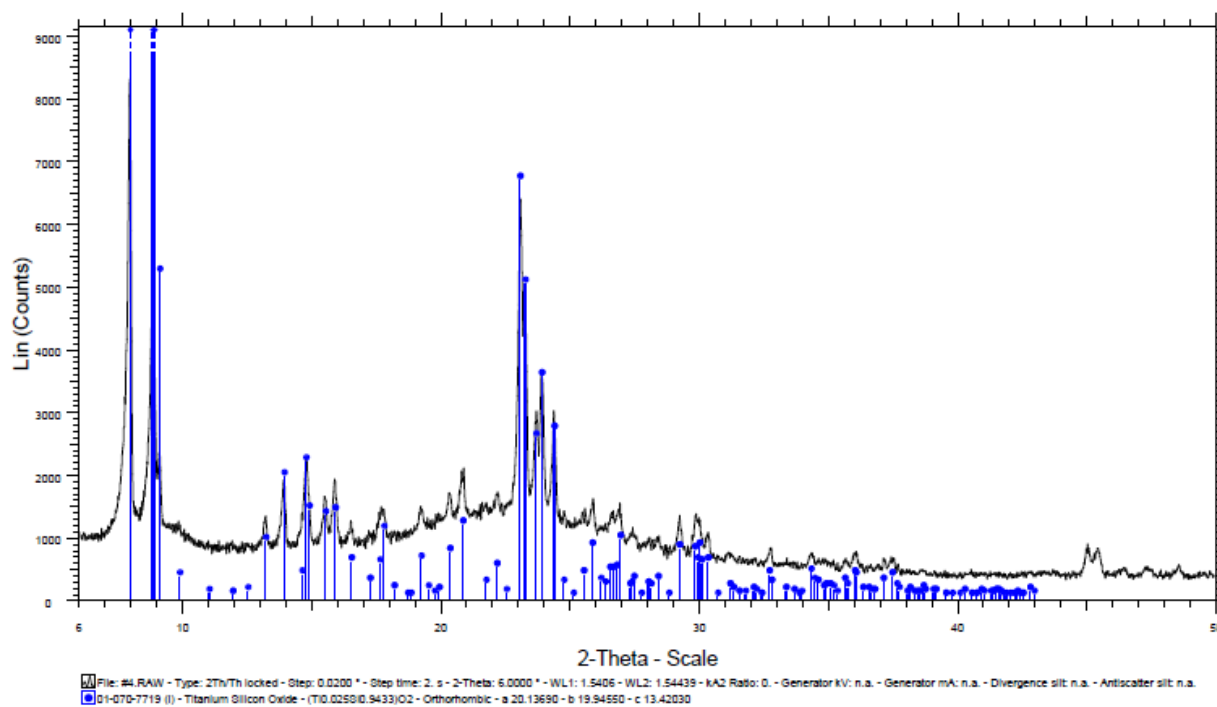


Figure S12. XRD pattern of sample H-TS with TMAB

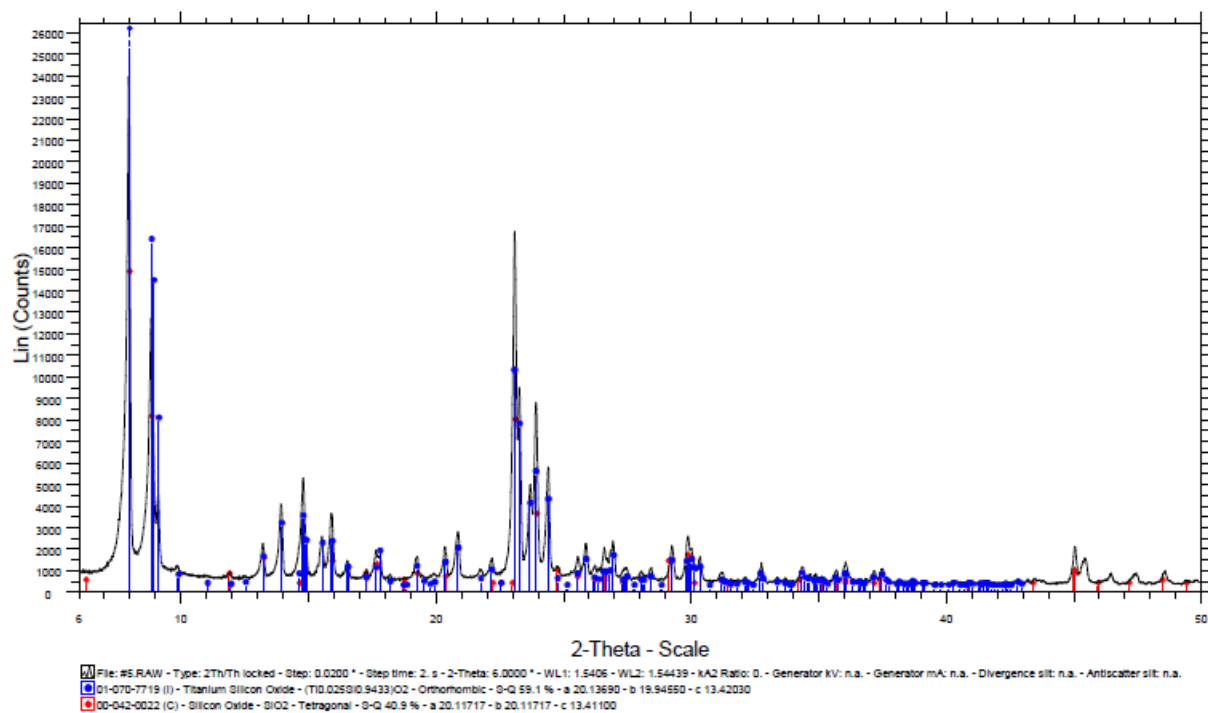


Figure S13. XRD pattern of sample H-TS with TEAB

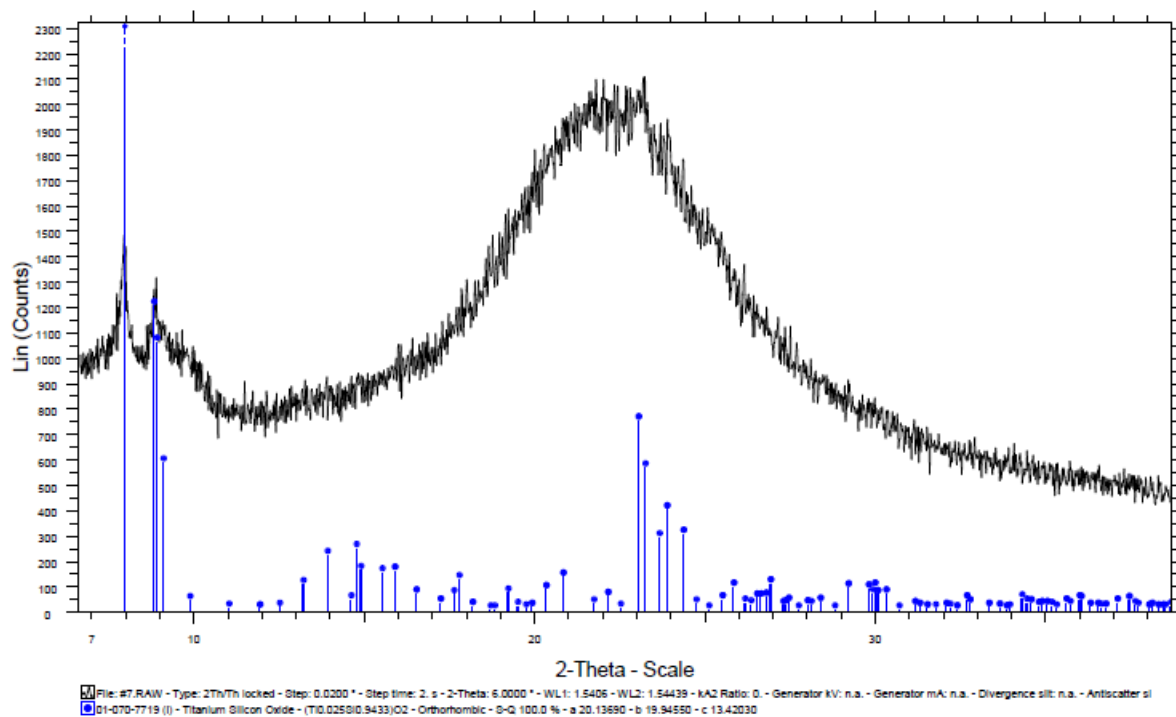


Figure S14. XRD pattern of sample H-TS with DDAC

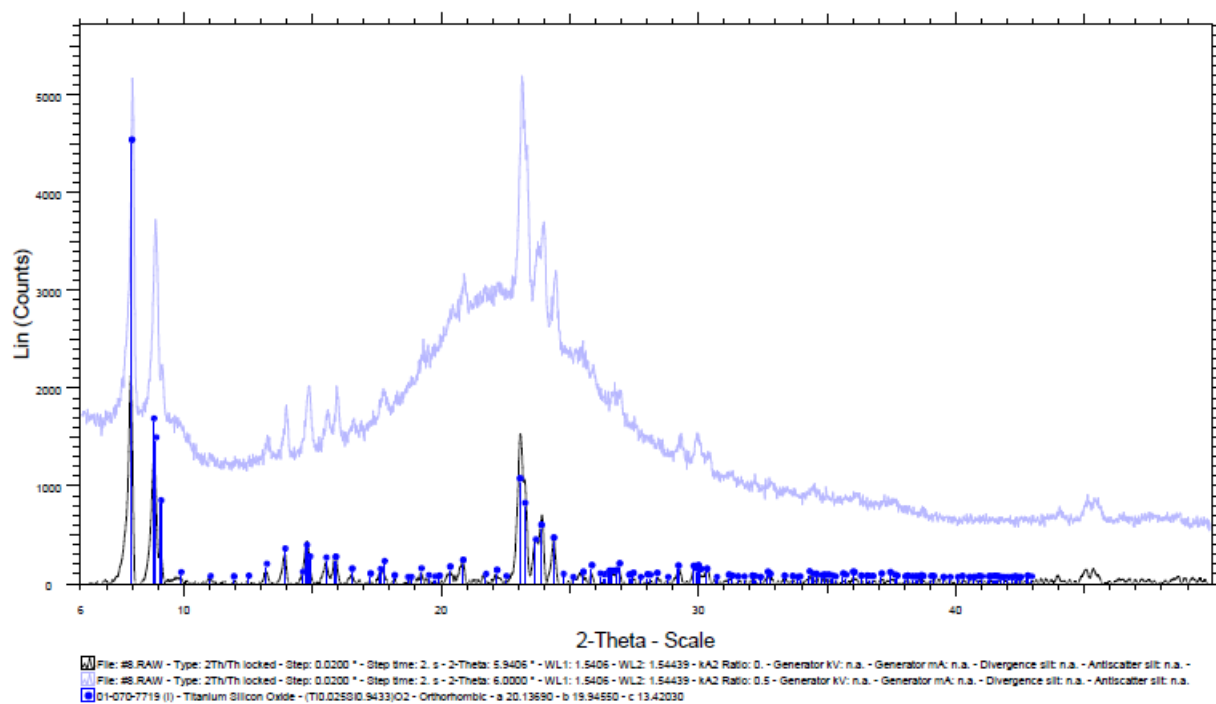


Figure S15. XRD pattern of sample H-TS with TBDAB

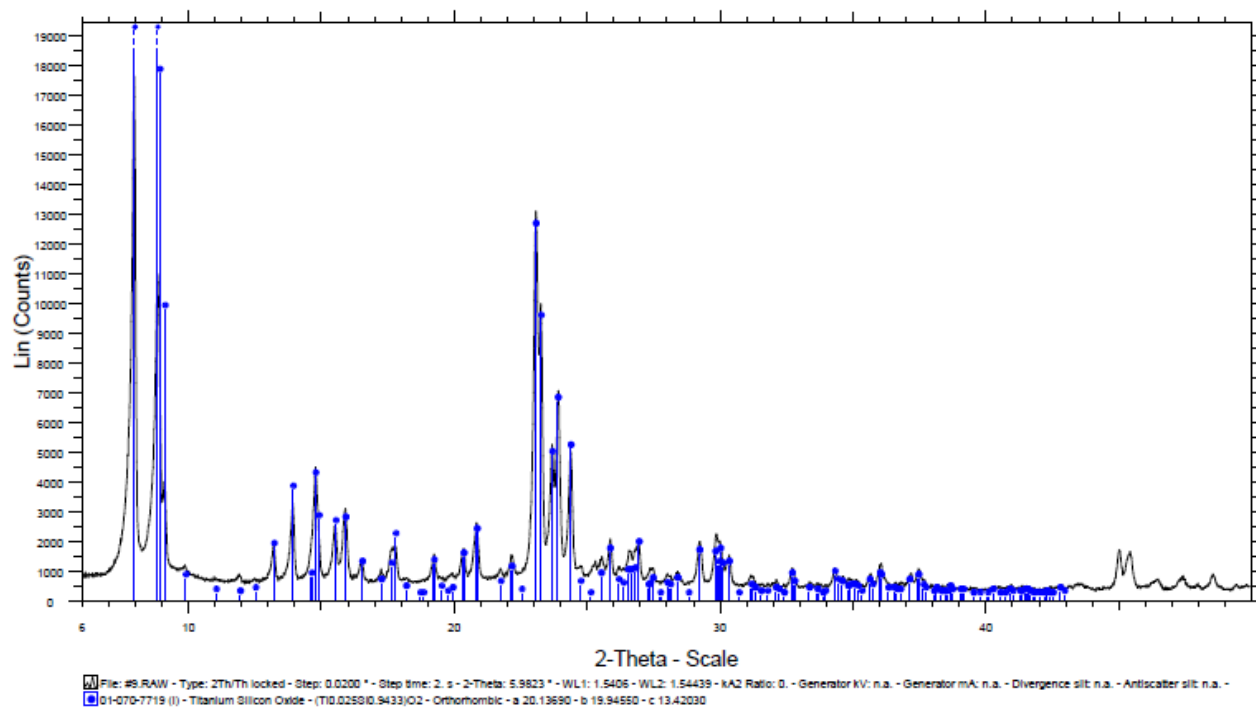


Figure S16. XRD pattern of sample H-TS with DTMAB

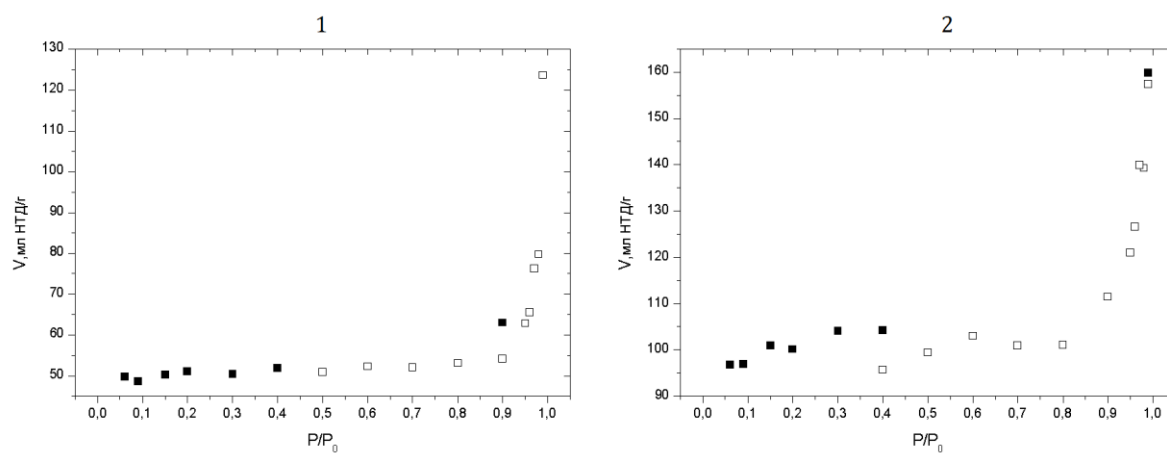


Figure S17. Nitrogen adsorption-desorption isotherm.

■ – adsorption; □ – desorption

1 - H-TS with TMAB; 2 - H-TS with TEAB

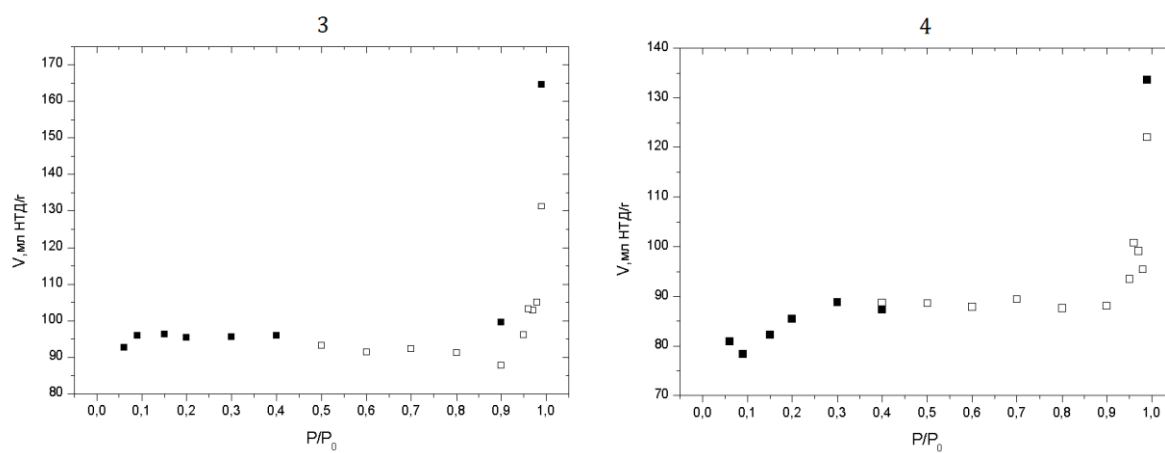


Figure S18. Nitrogen adsorption-desorption isotherm.

■ – adsorption; □ – desorption

3 - H-TS with TBAG; 4 - H-TS with DTMAB

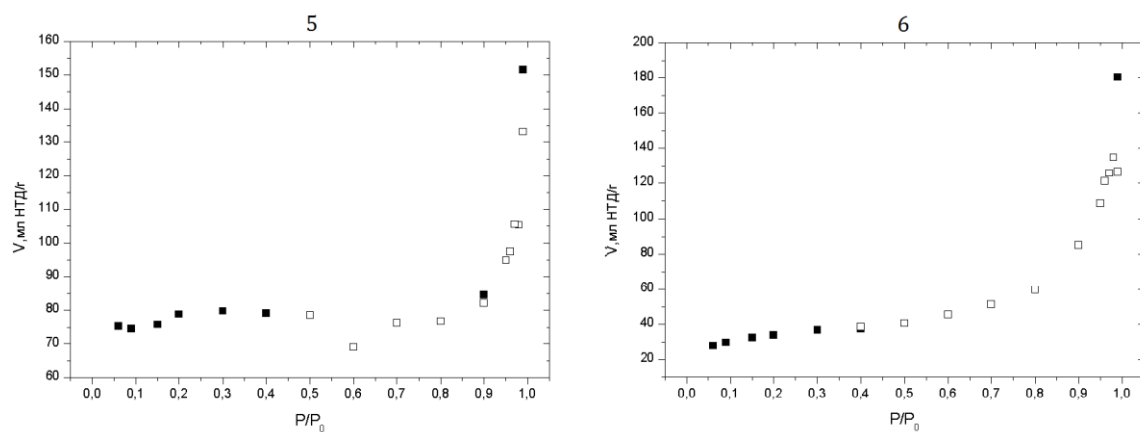


Figure S19. Nitrogen adsorption-desorption isotherm.

■ – adsorption; □ – desorption

5 - H-TS with CTAB; 6 - H-TS with TBDAC

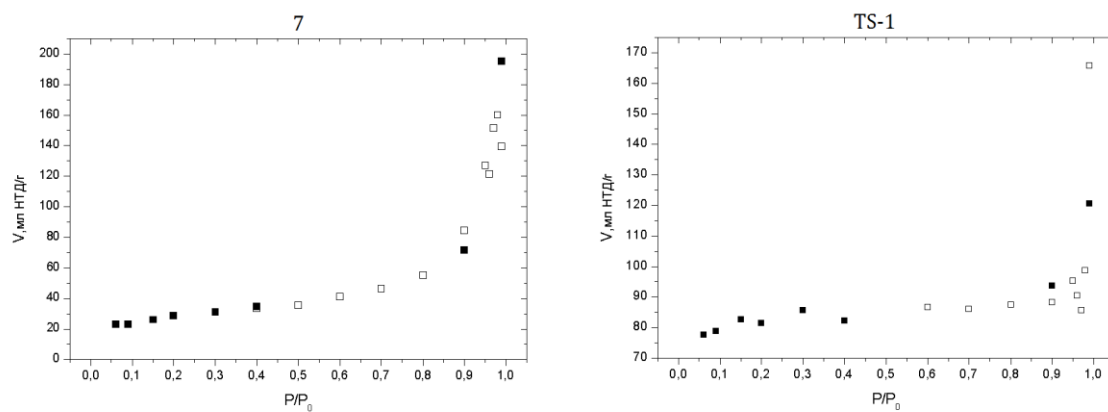


Figure S20. Nitrogen adsorption-desorption isotherm.

■ – adsorption; □ – desorption

7 - H-TS with DDAC; TS-1 – Titanium silicalite-1