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Appendices

JCPDF cards

05-0570 — Wavelength= 1 5405

PbO

Lead Oxide

Massicot, syn

Rad CuKa1λ: 1.5405 Filter Ni Beta M d-sp:

Cut off: Int.: Diffract I/Icor: 6.60

Ref: Swanson, Fuyat, Natl. Bur. Stand. (U.S.), Circ. 539, 2, 32 (1953)

Sys: Orthorhombic S.G.: Pbma (57)

a 5 489 b: 4.755 c: 5 891 A: 1.1544 C: 1 2389

α β: γ: Z: 4 mp

Ref: Kay, Acta Crystallogr., 14, 80 (1961)

Dx: 9.642 Dm: 9.642 SS/FOM30=29(.0157, 66)

Color: Yellow
X-ray pattern at 27 C. Sample from National Lead Company CAS #: 1317-36-8. Spectroscopic analysis: <0.01% Bi, Fe; <0.001% Al, Ag, Cu, Mg, Si, Ca. Other form, litharge. O Pb type. C.D. Cell: a=5.489, b=5.891, c=4.755, a/b=0.9318, c/b=0.8072, S.G.=Pcam(57). PSC oP8. Deleted by 38-1477. Mwt: 223.20. Volume[CD]: 15? 76.

2θ	Int	h	k	l	2θ	Int	h	k	l
15.021*	6	0	0	1	80.836*	3	4	2	0
29.090*	100	1	1	1	82.005*	4	3	3	1
30.313*	31	0	0	2	85.107*	2	2	2	4
32.604*	28	2	0	0	86.900*	2	1	1	5
35.994*	<1	2	0	1	88.687*	4	4	2	2
37.815*	20	2	1	0	89.821*	2	2	4	0
39.525*	<1	1	1	2					
40.930*	<1	2	1	1					
45.113*	12	2	0	2					
46.206*	2	0	0	3					
49.209*	14	0	2	2					
50.761*	14	2	2	0					
53.075*	15	1	1	3					
56.025*	13	3	1	1					
57.712*	<1	2	0	3					
60.281*	9	2	2	2					
61.161*	2	0	2	3					
63.008*	11	1	3	1					
66.330*	<1	3	2	1					
68.306*	1	4	0	0					
68.820*	<1	1	1	4					
71.087*	1	2	2	3					
72.864*	2	2	0	4					
73.390*	3	3	1	3					
75.935*	2	0	2	4					
76.511*	2	2	3	2					
79.625*	4	1	3	3					

05-0602 — Wavelength= 1.5405

La2O3

Lanthanum Oxide

Rad CuKa1 λ: 1 5405 Filter: Ni Beta M d-sp:

Cut off: Int: Diffract. I/Icor:

Ref: Swanson, Fuyat, Natl. Bur. Stand. (U.S.), Circ. 539, III, 33 (1954)

Sys: Hexagonal S.G.: P3m1 (164)

a 3.9373 b c: 6.1299 A C: 1.5569

α β γ Z: 1 mp

Ref: Ibid.

Dx: 6.574 Dm: SS/FOM 30=47(.0160, 40)

Color: Colorless
Pattern taken at 26 C. Sample from Fairmount Chemical Company. Sample was annealed at 1200 C for one hour and mounted in petrolatum to prevent reabsorption of CO2 + H2O. Spectroscopic analysis: <0.01% Ca, Mg, Si; <0.001% Al, Cu, Fe, Pb. Merck Index, 8th Ed., p. 608. Opaque mineral optical data on specimen from Namseke, Uganda: R3R%=14.2, Disp.=Std., VHN100=782-813. Ref.: IMA Commission on Ore Microscopy QDF. Pattern reviewed by Holzer, J., McCarthy, G., North Dakota State Univ., Fargo, ND, USA, ICDD Grant-in-Aid (1990). Validated by calculated pattern except for the following: 2.278 23 102, 1.963 28 110, 1.753 23 103. Calculated pattern indicates that the following reflections might be observable: 6.130 <1 001, 2.043 <1 003; 1.8744 <1 111, 1.4177 <1 113, 1.2260 <1 005. La2 O3 type. PSC: hP5. Mwt: 325.81. Volume[CD]: 82.30.

2θ	Int	h	k	l	2θ	Int	h	k	l
26.109*	34	1	0	0	130.547	2	1	0	7
29.129*	31	0	0	2	131.649	1	4	0	1
29.959*	100	1	0	1	136.844	2	2	2	4
39.525*	58	1	0	2	146.207	1	3	1	4
46.082*	63	1	1	0	148.296	2	2	1	6
52.130*	52	1	0	3					
53.713*	4	2	0	0					
55.437*	24	1	1	2					
55.951*	17	2	0	1					
60.367*	3	0	0	4					
62.255*	5	2	0	2					
66.867*	2	1	0	4					
72.091*	7	2	0	3					
73.390*	9	2	1	0					
75.298*	12	2	1	1					
79.151*	6	1	1	4					
80.841*	4	2	1	2					
83.761*	4	1	0	5					
85.047*	2	2	0	4					
85.316*	4	3	0	0					
89.916*	[illegible]	2	1	3					
92.555*	4	3	0	2					
97.818*	<1	1	0	6					
101.423	[illegible]	2	0	5					
103.043	[illegible]	2	2	0					
108.8[illegible]	[illegible]	1	0	[illegible]					
109.0[illegible]	<1	3	1	0					
110.5[illegible]	[illegible]	2	2	3					
111.023	3	3	1	1					
115.035	2	3	0	4					
116.256	2	[illegible]	1	5					
120.248	5	2	1	5					
122.967	[illegible]	2	0	6					
127.630	4	1	1	[illegible]					

37-1484 Wavelength = 1.5405981

ZrO_2

Zirconium Oxide

Baddeleyite, syn

Rad: CuKa1 λ: 1.5405 Filter: Graph Mono d-sp: Diffractometer

Cut off: 17.7 Int.: Diffract. I/Icor.: 2.6

Ref: McMurdie, H et al., Powder Diffraction, 1, 275 (1986)

Sys: Monoclinic S.G: $P2_1/a$ (14)

a: 5.3129(4) b: 5.2125(4) c: 5.1471(5) A: 1.0193 C: 0.9875

α β: 99.218(8) γ Z: 4 mp:

Ref: Ibid

Dx: 5.817 Dm: SS/FOM: F_{30}=111(.0073, 37)

Color: Colorless
Peak height intensity. The mean temperature of the data collection was 25.5°. Sample was obtained from Titanium Alloy Manufacturing Co. (1990) and was heated to 1300° for 48 hours. CAS #: 1314-23-4. Spectrographic analysis showed that this sample contained less than 0.01% each of Al, Hf and Mg and between 0.1 and 0.01% each of Fe, Si and Ti. Pattern reviewed by Holzer, J., McCarthy, G., North Dakota State Univ., Fargo, ND, USA, ICDD Grant-in-Aid (1990). Agrees well with experimental and calculated patterns. Additional weak reflections [indicated by brackets] were observed. σ(I_{obs})= ±1. There are a number of polymorphic forms of Zr O2 stable at different temperatures and pressures. The structure of Zr O2 (baddeleyite) was determined by McCullough and Trueblood (1) and confirmed by Smith and Newkirk (2). O2 Zr type. Also called: zirconium dioxide. Also called: zirkite. Silver, fluorophlogopite used as an internal stands. PSC: mP12. To replace 13-307 and 36-420 and validated by calculated pattern 24-1165. Mwt: 123.22 Volume[CD]: 140.70.

2θ	Int	h	k	l	2θ	Int	h	k	l
17.419*	3	0	0	1	65.884*	4	1	3	2
24.048*	14	1	1	0	68.912*	1	2	3	1
24.441*	10	0	1	1	69.620*	<1	3	2	1
28.175	100	1	1	1	70.190*	<1	3	2	2
31.468*	68	1	1	1	71.071*	2	2	2	3
34.160*	21	2	0	0	71.300*	4	4	0	1
34.383*	11	0	2	0	71.950*	1	4	0	0
35.309*	13	0	0	2	72.104*	1	2	3	2
35.900*	2	$\bar{2}$	0	1	72.450*	<1	0	4	0
38.396	1	[2	1	0]	72.642*	<1	3	1	2
38.541*	4	1	2	0	73.580*	<1	$\bar{3}$	1	3
39.411*	<1	0	1	2	74.682*	2	0	0	4
39.990*	<1	2	1	1	75.046*	4	1	4	0
40.725*	12	$\bar{1}$	1	2	76.410*	1	1	1	4
41.150*	5	2	0	1	77.392*	<1	3	3	0
41.374*	5	$\bar{1}$	2	1	78.079*	<1	4	0	1
44.826*	7	$\bar{2}$	1	1	78.866*	1	0	3	3
45.522*	6	$\bar{2}$	0	2					
48.949*	2	$\bar{2}$	1	2					
49.266*	18	2	2	0					
50.116*	22	0	2	2					
50.559*	13	$\bar{2}$	2	1					
51.193*	5	$\bar{1}$	2	2					
54.104*	11	0	0	3					
54.680*	<1	2	2	1					
55.270	11	[1	2	2]					
55.400*	11	3	1	0					
55.570*	9	$\bar{3}$	1	1					
55.883*	6	0	3	1					
57.168*	7	$\bar{1}$	1	3					
57.861*	4	$\bar{1}$	3	1					
58.268*	3	$\bar{2}$	2	2					
59.775*	8	1	3	1					
60.055*	7	$\bar{2}$	0	3					
61.367*	5	3	1	1					
61.984*	5	$\bar{3}$	1	2					
62.838*	8	1	1	3					
64.079*	1	3	2	0					
64.250*	2	2	3	0					
64.966*	<1	0	3	2					
65.384*	2	$\bar{2}$	3	1					
65.700*	6	0	2	3					

04-0477 Wavelength = 1.54056

TiO_2

Titanium Oxide

Anatase, syn

Rad: CuKa1 λ: 1.5405 Filter: Ni Beta M d-sp: Diffractometer

Cut off: Int: Diffract. I/Icor:

Ref: Swanson, Tatge, Private Communication, (1950)

Sys: Tetragonal S.G: $I4_1/amd$ (141)

a: 3.785 b: c: 9.51 A: C: 2.5139

α β γ Z: 4 mp:

Ref: Ibid

Dx: 3.899 Dm: SS/FOM: F_{25}= 8(.062, 48)

PSC: tI12. Mwt: 79.90. Volume[CD]: 136.10

2θ	Int	h	k	l	2θ	Int	h	k	l
25.354	100	1	0	1	120.391	2	2	2	8
36.883*	9	1	0	3	135.889	<1	3	2	7
37.784*	22	0	0	4	137.384	3	4	1	5
38.506*	9	1	1	2	143.965	1	3	0	9
48.076*	33	2	0	0	149.183	3			
53.921*	21	1	0	5					
55.114*	19	2	1	1					
62.073*	4	2	1	3					
62.726*	13	2	0	4					
68.594*	5	1	1	6					
70.357*	5	2	2	0					
75.092*	10	2	1	5					
76.082*	3	3	0	1					
82.264*	2	3	0	3					
83.138*	3	3	1	2					
90.258*	3								
95.176*	3	3	2	1					
98.433*	2	1	0	9					
107.525	4	3	1	6					
109.009	3	4	0	0					
113.914	2	3	2	5					
118.563	3	1	1	10					

33-0784 — Wavelength 1.5418

$Pb(Zr_{0.52}Ti_{0.48})O_3$

Lead Zirconium Titanium Oxide

Rad. CuKa λ 1.5418 Filter Ni Beta□M d-sp. Diffractometer

Cut off Int. Diffract I/Icor.

Ref. Kakegawa, K et al., Solid State Commun., 24, 769 (1977)

Sys. Tetragonal S.G.

a: 4.036 b: c: 4.146 A C: 1.0273

α β γ Z: 1 mp

Ref. Ibid.

Dx: 8.006 Dm. SS/FOM30=15(.060, 34)

Color: Light yellow
No composition fluctuation. Silicon used as an internal stand. Mwt. 325.62. Volume[CD]: 67.54.

2θ	Int	h	k	l	2θ	Int	h	k	l
21.432*	9	0	0	1	78.379*	2	3	1	1
22.023*	12	1	0	0	85.099*	4	2	0	3
30.942	100	1	0	1	86.034*	4	3	0	2
31.387	100	1	1	0	86.992*	4	3	2	0
38.283*	15	1	1	1	88.985*	15	1	2	3
43.663*	9	0	0	2	90.023*	15	3	1	2
44.917*	16	2	0	0	91.089*	15	3	2	1
49.424*	5	1	0	2	96.092*	<1	0	0	4
50.417*	6	2	0	1	99.627*	<1	4	0	0
50.417*	6	2	1	0	100.319	<1	1	0	4
53.390*	5				101.881	<1	2	2	3
54.734*	12	1	1	2	102.991	1	3	2	2
55.524*	24	2	1	1	104.602	2	1	1	4
64.434*	9	0	2	2	106.185	2	3	0	3
65.398*	5	2	2	0	107.981	4	4	1	1
67.810*	2	0	0	3	108.313	4	3	3	0
69.002*	6	2	1	2	110.595	1	1	3	3
69.645*	6	2	2	1	112.473	<1	3	3	1
69.645*	6	3	0	0	113.446	2	2	0	4
72.225*	6	1	0	3	116.411	6	4	0	2
74.065*	9	3	0	1	117.235	6	4	2	0
74.065*	9	3	1	0	118.076	6	1	2	4
76.588*	2	1	1	3	121.167	1	4	1	2

2θ	Int	h	k	l
121.862	1	4	2	1
124.798	3	2	3	3
126.131	2	3	3	2
133.607	1	2	2	4
136.843	5	0	0	5
137.195	5	4	2	2
139.685	2	3	0	4

12-0001 — Wavelength= 1.5418

$PbTiO_3$

Lead Titanium Oxide

Rad.: CuKa λ: 1.5418 Filter: d-sp:

Cut off: Int.: I/Icor.:

Ref: Cedana, S., EP 186,199, Eur. Pat. Appl., (1986)

Sys.: Tetragonal S.G.: [illegible]

a: [illegible] c: [illegible] A C: [illegible]

α β γ Z: mp

Ref: Ibid.

Dx: Dm: SS/FOM: [illegible]

[illegible]

2θ	Int	h	k	l	2θ	Int	h	k	l
14.330*	22	2	0	0	57.530*	<2	7	2	3
22.760*	55	3	1	0	57.810*	2	5	3	6
24.460*	8	2	1	3	59.620*	2	6	4	4
24.460*	8	0	0	4					
28.910*	22	4	0	0					
30.710	100	3	3	0					
32.000*	45	3	2	3					
32.400*	12	4	2	0					
35.200*	8	4	1	3					
37.080*	2	5	1	0					
38.200*	6	4	0	4					
41.310*	2	4	4	0					
42.690*	<2	5	3	0					
43.650*	[illegible]	5	2	3					
43.950*	16	6	0	0					
46.480*	4	6	2	0					
47.750*	6	4	0	6					
50.150*	<2	4	[illegible]	6					
50.150	<2	0	0	8					
50.230*	6	5	4	3					
52.360*	[illegible]	[illegible]	[illegible]	6					
53.170*	<2	6	2	4					
53.470*	14	6	4	0					
55.400*	20	7	0	3					
56.730*	5	7	3	0					

35-0739 Wavelength= 1.5405981 *

$PbZrO_3$

Lead Zirconium Oxide

Rad.: CuKa1 λ: 1.5405 Filter: Graph Mono d-sp: Diffractometer

Cut off: 22.1 Int.: Diffract. I/Icor.:

Ref: Natl. Bur. Stand. (U.S.) Monogr. 25, 21, 74 (1984)

Sys.: Orthorhombic S.G.: P2cb (32)

a: 8.2301(3) b: 11.7764(3) c: 5.8616(7) A: 0.6990 C: 0.4994

α: β: γ: Z: 8 mp:

Ref: Ibid.

Dx: 8.071 Dm: SS/FOM $_{30}$=44(.0093, 73)

Color: Gray yellow

Peak height intensity. CAS #: 12060-01-4. The sample was made by heating PbO and Zr O2 together at 900 C overnight. The temperature of data collection was approximately 25.0 C. σ(I obs)= ±1. Above about 150 C Pb Zr O3 is cubic, perovskite type. Earlier this phase was considered tetragonal. Distorted perovskite, Ca O3 Ti type. Silicon used as an internal stand. PSC: oP40. Mwt: 346.42. Volume[CD]: 570.17.

2θ	Int	h	k	l	2θ	Int	h	k	l
16.825*	2	0	1	1	54.016*	30	2	6	1
21.325*	8	0	2	1	54.362*	18	4	0	2
21.559*	5	2	0	0	55.001*	1	4	1	2
27.261*	3	0	3	1	57.026*	2	2	3	3
27.498*	4	2	1	1	57.496*	<1	1	6	2
30.337*	66	0	4	0	59.650*	<1	4	3	2
30.519	100	2	2	1	61.496*	<1	0	2	3
31.335*	4	0	1	2	63.101*	5	0	6	0
34.059*	<1	0	2	2	63.536*	9	4	4	2
35.041*	<1	2	3	1	65.968*	1	2	5	3
35.751*	<1	1	4	1	66.301*	1	4	1	3
37.523*	14	2	4	0	67.475*	<1	0	6	3
38.201*	2	0	3	2	67.853*	1	4	2	3
38.338*	3	2	1	2	68.084*	2	2	7	2
40.678*	<1	2	2	2	68.346*	2	4	5	2
43.458*	24	0	4	2	68.541*	<1	1	6	3
43.962*	14	4	0	0					
44.298*	2	2	3	2					
46.937*	2	0	1	3					
47.820*	<1	3	4	1					
48.883*	2	0	6	1					
49.005*	2	2	4	2					
49.372*	2	4	2	1					
50.249*	<1	1	2	3					
51.098*	<1	3	3	2					
51.548*	<1	2	6	0					
52.111*	3	0	3	3					
52.224*	4	2	1	3					

XRD data of raw oxide mixture of PLZT (3/52/48)

JEOL — Peak search

No	2-theta	d-value	INT.	I/Io	No.	2-theta	d-value	INT	I/Io
1	14.960	5.91704	895	28	21	53.120	1.72270	421	13
2	17.560	5.04636	465	14	22	54.640	1.67832	340	11
3	24.000	3.70485	269	8	23	55.960	1.64182	319	10
4	25.240	3.52557	359	11	24	59.720	1.54711	354	11
5	26.440	3.36822	312	10	25	63.080	1.47255	383	12
6	28.160	3.16628	680	21					
7	28.560	3.12284	828	26					
8	29.040	3.07230	1057	33					
9	30.280	2.94925	3213	100					
10	31.360	2.85010	368	11					
11	31.800	2.81166	585	18					
12	32.480	2.75433	324	10					
13	32.560	2.74775	379	12					
14	34.120	2.62560	300	9					
15	35.680	2.51430	812	25					
16	37.840	2.37559	333	10					
17	45.120	2.00777	325	10					
18	46.160	1.96492	349	11					
19	48.520	1.87472	486	15					
20	49.200	1.85039	316	10					

XRD of PLZT calcined at 850 °C

No	2-theta	d-value	INT	I/Io
1	21.500	4.12966	346	39
2	22.700	3.91399	236	27
3	30.600	2.91913	879	100
4	31.500	2.83775	447	51
5	32.299	2.76935	250	28
6	39.200	2.29625	250	28
7	43.900	2.06069	313	36
8	54.500	1.68230	310	35
9	57.200	1.60914	218	25

XRD of undoped PLZT powder calcined at 950 °C

No	2-theta	d-value	INT	I/Io
1	21.520	4.12587	477	20
2	22.060	4.02608	622	25
3	31.040	2.87875	2443	100
4	31.340	2.85188	1410	58
5	38.360	2.34458	650	27
6	43.800	2.06516	348	14
7	44.900	2.01709	558	23
8	49.740	1.83156	314	13
9	50.540	1.80443	302	12
10	54.960	1.66930	464	19
11	55.500	1.65433	609	25

XRD of undoped PLZT ceramic sintered at 1250 °C

No	2-theta	d-value	INT	I/Io
1	21.480	4.13346	390	22
2	22.040	4.02969	180	10
3	30.920	2.88965	1791	100
4	31.320	2.85365	555	31
5	38.280	2.34929	501	28
6	43.760	2.06696	363	20
7	44.880	2.01794	345	19
8	49.520	1.83918	282	16
9	50.440	1.80777	189	11
10	54.720	1.67605	353	20
11	55.520	1.65378	482	27

XRD of B_2O_3 doped PLZT ceramics sintered at 1250 °C

No.	2-theta	d-value	INT	I/Io
1	21.480	4.13346	387	22
2	21.960	4.04418	189	11
3	30.920	2.88965	1743	100
4	31.240	2.86078	595	34
5	38.240	2.35166	441	25
6	43.760	2.06696	338	19
7	44.520	2.03342	204	12
8	44.720	2.02479	298	17
9	49.640	1.83501	243	14
10	50.240	1.81449	204	12
11	54.720	1.67605	311	18
12	55.440	1.65598	434	25

XRD of BaO doped PLZT ceramics sintered at 1250 °C

JEOL

No	2-theta	d-value	INT	I/Io
1	21.480	4.13346	346	20
2	21.920	4.05147	207	12
3	30.920	2.88965	1758	100
4	31.240	2.86077	634	36
5	38.280	2.34929	478	27
6	43.840	2.06337	371	21
7	44.800	2.02136	376	21
8	49.520	1.83918	287	16
9	50.360	1.81045	182	10
10	54.800	1.67380	399	23
11	55.480	1.65488	454	26
12	64.520	1.44312	273	16

XRD of Bi_2O_3 doped PLZT ceramics sintered at 1250 °C

JEOL

No.	2-theta	d-value	INT	I/Io
1	21.479	4.13365	424	24
2	21.920	4.05147	182	10
3	30.920	2.88965	1781	100
4	31.280	2.85721	608	34
5	38.280	2.34929	484	27
6	43.760	2.06696	399	22
7	44.840	2.01965	351	20
8	49.560	1.83779	289	16
9	50.440	1.80777	198	11
10	54.800	1.67380	424	24
11	55.480	1.65488	467	26
12	64.560	1.44232	267	15

XRD of CoO doped PLZT ceramics sintered at 1250 °C

JEOL

No	2-theta	d-value	INT	I/Io
1	21.440	4.14108	383	24
2	21.960	4.04418	197	12
3	30.880	2.89330	1612	100
4	[illegible]	2.86078	535	33
5	38.240	2.35166	446	28
6	43.760	2.06696	363	23
7	44.840	2.01965	338	21
8	49.440	1.84197	282	17
9	54.720	1.67605	423	26
10	55.480	1.65488	443	27
11	64.440	1.44471	258	16

XRD of Cr_2O_3 doped PLZT ceramics sintered at 1250 °C

JEOL

No	2 theta	d-value	INT.	I/Io
1	21.520	4.12587	355	22
2	22.000	4.03692	180	11
3	31.000	2.88237	1646	100
4	31.320	2.85365	548	33
5	38.320	2.34693	441	27
6	43.800	2.06516	336	20
7	44.920	2.01624	320	19
8	49.520	1.83918	226	14
9	50.480	1.80643	175	11
10	54.880	1.67155	422	26
11	55.560	1.65269	414	25
12	64.639	1.44075	247	15

XRD of CuO doped PLZT ceramics sintered at 1250 °C

JEOL

No	2-theta	d-value	INT	I/Io
1	21.480	4.13346	388	22
2	21.920	4.05147	218	12
3	30.920	2.88965	1789	100
4	31.240	2.86078	687	38
5	38.240	2.35166	482	27
6	43.720	2.06876	331	19
7	44.840	2.01965	353	20
8	49.520	1.83918	257	14
9	50.280	1.81314	171	10
10	54.800	1.67380	395	22
11	55.480	1.65488	442	25
12	64.480	1.44392	274	15

XRD of Fe_2O_3 doped PLZT ceramics sintered at 1250 °C

JEOL

No	2-theta	d-value	INT	I/Io
1	21.440	4.14108	416	24
2	21.920	4.05147	204	12
3	30.880	2.89330	1739	100
4	31.200	2.86435	536	31
5	38.240	2.35166	464	27
6	43.720	2.06876	342	20
7	44.760	2.02307	315	18
8	49.440	1.84197	261	15
9	54.680	1.67719	368	21
10	55.400	1.65708	407	23
11	64.520	1.44312	271	16

XRD of Gd_2O_3 doped PLZT ceramics sintered at 1250 °C

JEOL

No	2-theta	d-value	INT.	I/Io
1	21.480	4.13346	365	20
2	21.960	4.04418	203	11
3	30.920	2.88965	1806	100
4	31.240	2.86078	599	33
5	38.240	2.35166	460	25
6	43.800	2.06516	350	19
7	44.800	2.02136	350	19
8	49.520	1.83918	250	14
9	50.360	1.81045	202	11
10	54.760	1.67492	355	20
11	55.440	1.65598	469	26

XRD of K_2O doped PLZT ceramics sintered at 1250 °C

JEOL

No	2-theta	d-value	INT.	I/Io
1	21.440	4.14108	432	23
2	21.960	4.04418	234	13
3	30.920	2.88965	1862	100
4	31.280	2.85721	630	34
5	38.320	2.34693	436	23
6	43.720	2.06876	347	19
7	44.840	2.01965	369	20
8	49.520	1.83918	277	15
9	50.240	1.81449	204	11
10	54.760	1.67492	334	21
11	55.480	1.65488	448	24

XRD of Li_2O doped PLZT ceramics sintered at 1250 °C

No.	2-theta	d-value	INT	I/Io
1	21.440	4.14108	357	22
2	21.920	4.05147	179	11
3	30.880	2.89330	1619	100
4	31.240	2.86078	577	36
5	38.240	2.35166	461	28
6	43.720	2.06876	351	22
7	44.800	2.02136	362	22
8	49.440	1.84197	274	17
9	50.280	1.81314	172	11
10	54.760	1.67492	376	23
11	55.400	1.65708	439	27

XRD of Mn_2O_3 doped PLZT ceramics sintered at 1250 °C

No	2-theta	d-value	INT	I/Io
1	21.480	4.13346	336	21
2	22.000	4.03692	205	13
3	30.960	2.88601	1638	100
4	31.240	2.86078	574	35
5	38.320	2.34693	424	26
6	43.840	2.06337	313	19
7	44.880	2.01794	317	19
8	49.480	1.84057	221	13
9	50.280	1.81314	161	10
10	54.880	1.67155	374	23
11	55.520	1.65378	424	26
12	64.639	1.44075	231	14

XRD of Nb_2O_5 doped PLZT ceramics sintered at 1250 °C

No.	2-theta	d-value	INT	I/Io
1	21.440	4.14108	299	18
2	21.760	4.08090	228	14
3	30.880	2.89330	1646	100
4	38.240	2.35166	435	26
5	43.760	2.06696	288	17
6	44.480	2.03516	296	18
7	49.400	1.84336	205	12
8	50.080	1.81992	232	14
9	54.720	1.67605	320	19
10	55.400	1.65708	370	22
11	64.560	1.44232	225	14
12	64.800	1.43756	214	13

XRD of NiO doped PLZT ceramics sintered at 1250 °C

No.	2-theta	d-value	INT	I/Io
1	21.440	4.14108	366	22
2	21.920	4.05147	210	12
3	30.880	2.89330	1697	100
4	31.200	2.86435	631	37
5	38.200	2.35403	437	26
6	43.800	2.06516	316	19
7	44.760	2.02307	355	21
8	49.520	1.83918	239	14
9	50.280	1.81314	173	10
10	54.760	1.67492	358	21
11	55.440	1.65598	446	26
12	64.600	1.44152	239	14

XRD of SeO_2 doped PLZT ceramics sintered at 1250 °C

JEOL

No	2-theta	d-value	INT	I/Io
1	21.440	4.14108	406	22
2	21.920	4.05147	232	12
3	30.880	2.89330	1887	100
4	31.240	2.86078	648	34
5	38.280	2.34929	479	25
6	43.720	2.06876	339	18
7	44.760	2.02307	339	18
8	48.360	1.88055	147	8
9	49.520	1.83918	255	14
10	54.800	1.67380	391	21
11	55.440	1.65598	449	24

XRD of SnO_2 doped PLZT ceramics sintered at 1250 °C

JEOL

No.	2-theta	d-value	INT	I/Io
1	21.480	4.13346	352	20
2	21.920	4.05147	241	14
3	30.920	2.88965	1729	100
4	31.200	2.86435	669	39
5	38.240	2.35166	474	27
6	43.800	2.06516	300	17
7	44.760	2.02307	355	21
8	49.480	1.84057	238	14
9	50.240	1.81449	200	12
10	54.760	1.67492	351	20
11	55.480	1.65488	456	26

XRD of SrO doped PLZT ceramics sintered at 1250 °C

JEOL

No.	2-theta	d-value	INT	I/Io
1	21.440	4.14108	443	24
2	21.920	4.05147	206	11
3	30.880	2.89330	1831	100
4	31.240	2.86078	623	34
5	38.240	2.35166	458	25
6	43.760	2.06696	362	20
7	44.800	2.02136	362	20
8	49.560	1.83779	252	14
9	54.720	1.67605	340	19
10	55.360	1.65818	401	22

XRD of V_2O_5 doped PLZT ceramics sintered at 1250 °C

JEOL

No	2-theta	d-value	INT	I/Io
1	21.440	4.14108	424	23
2	21.920	4.05147	200	11
3	30.920	2.88965	1830	100
4	31.159	2.86803	624	34
5	38.280	2.34929	483	26
6	43.760	2.06696	371	20
7	44.800	2.02136	330	18
8	49.560	1.83779	279	15
9	50.280	1.81314	204	11
10	54.760	1.67493	428	23
11	55.440	1.65598	429	23
12	64.560	1.44232	261	14

XRD of WO_3 doped PLZT ceramics sintered at 1250 °C

No	2-theta	d-value	INT	I/Io
1	21.520	4.12587	301	20
2	21.799	4.07369	258	17
3	30.840	2.89696	1499	100
4	38.280	2.34929	467	31
5	44.000	2.05624	298	20
6	44.520	2.03342	356	24
7	49.520	1.83918	209	14
8	50.080	1.81992	221	15
9	54.760	1.67492	333	22
10	55.200	1.66261	502	33
11	64.720	1.43914	265	18

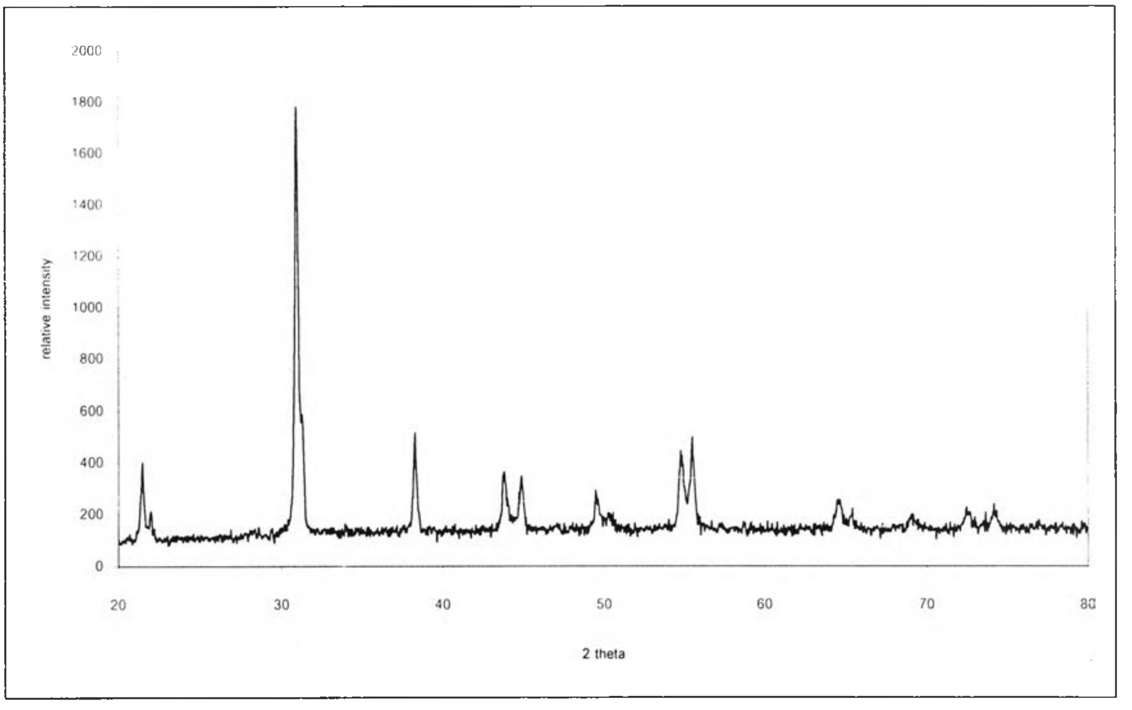
XRD of Y_2O_3 doped PLZT ceramics sintered at 1250 °C

No	2-theta	d-value	INT	I/Io
1	21.440	4.14108	456	23
2	21.960	4.04418	211	11
3	30.880	2.89330	1999	100
4	31.240	2.86078	662	33
5	38.240	2.35166	461	23
6	43.800	2.06516	366	18
7	44.800	2.02136	360	18
8	49.440	1.84197	284	14
9	50.200	1.81585	199	10
10	54.880	1.67155	409	20
11	55.440	1.65598	454	23
12	63.920	1.45521	166	8

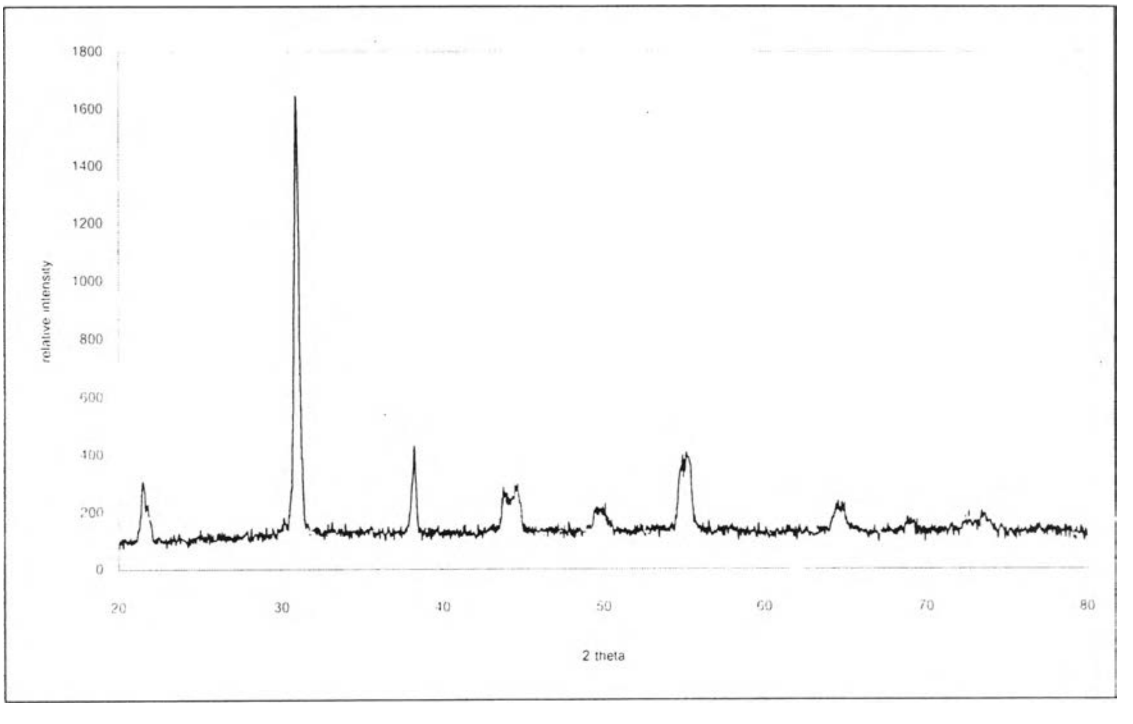
XRD of ZnO doped PLZT ceramics sintered at 1250 °C

No	2-theta	d value	INT	I/Io
1	21.400	4.14873	385	21
2	21.880	4.05879	208	11
3	30.880	2.89330	1856	100
4	31.200	2.86435	608	33
5	38.240	2.35166	463	25
6	43.720	2.06876	386	21
7	44.800	2.02136	333	18
8	49.440	1.84197	271	15
9	50.400	1.80911	170	9
10	54.720	1.67605	407	22
11	55.440	1.65598	454	24
12	64.440	1.44471	261	14

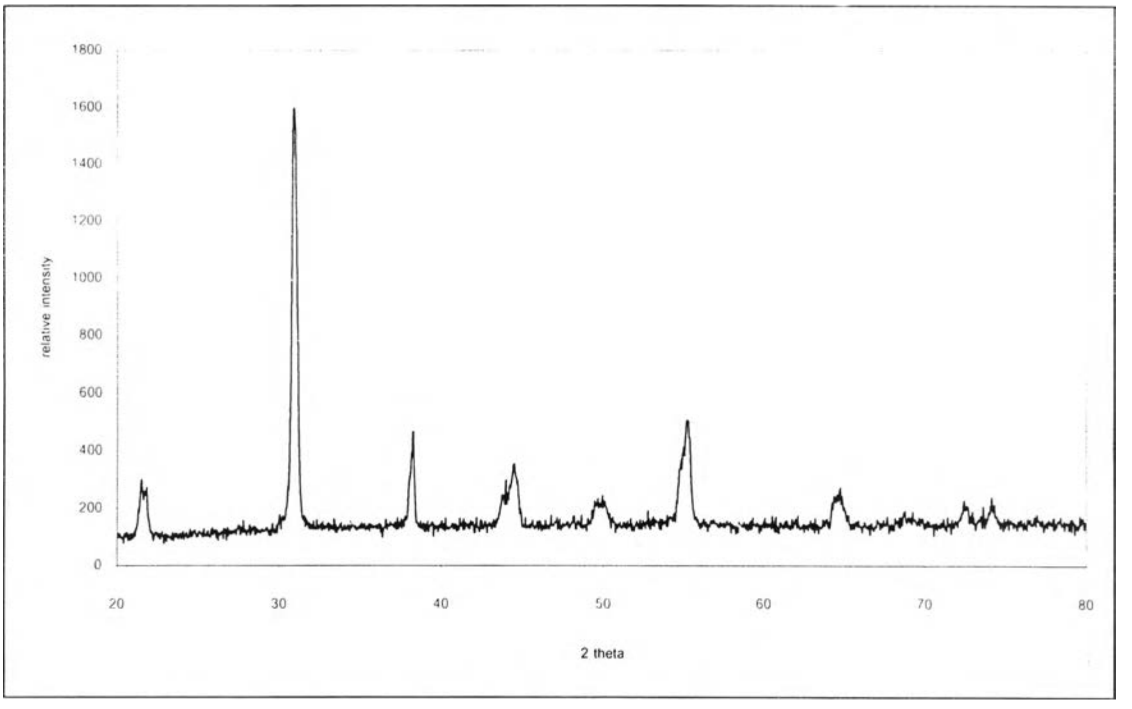
XRD pattern of sintered PLZT (3/52/48)



XRD pattern of 0.5 at% Nb_2O_5 doped PLZT (3/52/48)



XRD pattern of 0.5 at% WO_3 doped PLZT (3/52/48)



Formula and molecular weight of 0.5 at% doped PLZT (3/52/48)

Ions	Formula	Molecular Weight
Ba^{2+}	$(Pb_{0.965}La_{0.03}Ba_{0.005})(Zr_{0.5161}Ti_{0.4764})O_3$	322.84
Bi^{3+}	$(Pb_{0.965}La_{0.03}Bi_{0.005})(Zr_{0.51545}Ti_{0.4758})O_3$	322.70
Gd^{3+}	$(Pb_{0.965}La_{0.03}Gd_{0.005})(Zr_{0.51545}Ti_{0.4758})O_3$	322.97
K^{+}	$(Pb_{0.965}La_{0.03}K_{0.005})(Zr_{0.51675}Ti_{0.477})O_3$	323.17
Sr^{2+}	$(Pb_{0.965}La_{0.03}Sr_{0.005})(Zr_{0.5161}Ti_{0.4764})O_3$	323.05
Y^{3+}	$(Pb_{0.965}La_{0.03}Y_{0.005})(Zr_{0.51545}Ti_{0.4758})O_3$	323.19
Undoped	$\mathbf{(Pb_{0.97}La_{0.03})(Zr_{0.5161}Ti_{0.4764})O_3}$	**323.05**
B^{3+}	$(Pb_{0.97}La_{0.03})(Zr_{0.51415}Ti_{0.4746}B_{0.005})O_3$	323.06
Co^{2+}	$(Pb_{0.97}La_{0.03})(Zr_{0.5148}Ti_{0.4752}Co_{0.005})O_3$	322.71
Cr^{3+}	$(Pb_{0.97}La_{0.03})(Zr_{0.51415}Ti_{0.4746}Cr_{0.005})O_3$	322.30
Cu^{2+}	$(Pb_{0.97}La_{0.03})(Zr_{0.5148}Ti_{0.4752}Cu_{0.005})O_3$	323.00
Fe^{3+}	$(Pb_{0.97}La_{0.03})(Zr_{0.51415}Ti_{0.4746}Fe_{0.005})O_3$	323.06
Li^{+}	$(Pb_{0.97}La_{0.03})(Zr_{0.51545}Ti_{0.4758}Li_{0.005})O_3$	323.07
Mn^{3+}	$(Pb_{0.97}La_{0.03})(Zr_{0.51415}Ti_{0.4746}Mn_{0.005})O_3$	323.17
Nb^{5+}	$(Pb_{0.97}La_{0.03})(Zr_{0.51285}Ti_{0.4734}Nb_{0.005})O_3$	323.09
Ni^{2+}	$(Pb_{0.97}La_{0.03})(Zr_{0.5148}Ti_{0.4752}Ni_{0.005})O_3$	323.29
Se^{4+}	$(Pb_{0.97}La_{0.03})(Zr_{0.5135}Ti_{0.474}Se_{0.005})O_3$	322.45
Sn^{4+}	$(Pb_{0.97}La_{0.03})(Zr_{0.5135}Ti_{0.474}Sn_{0.005})O_3$	322.86
V^{5+}	$(Pb_{0.97}La_{0.03})(Zr_{0.51285}Ti_{0.4734}V_{0.005})O_3$	323.44
W^{6+}	$(Pb_{0.97}La_{0.03})(Zr_{0.5122}Ti_{0.4728}W_{0.005})O_3$	322.37
Zn^{2+}	$(Pb_{0.97}La_{0.03})(Zr_{0.5148}Ti_{0.4752}Zn_{0.005})O_3$	323.20

Vita

Mr. Thanakorn Wasanapiarnpong was born on Thursday 9th of May 1974. He was in Samutsakorn. After graduating with a Bachelor Degree in Materials Science from Faculty of Science, Chulalongkorn University in 1998, he worked in Raw Material Preparation division of Siam Sanitary Ware Industry Co. Ltd., for 3 years. He continued a further study in Master Degree in the field of Ceramic Technology at Chulalongkorn University in 1999 and graduated in April 2001.