LIST OF FIGURES

Figure 2.1 Phase diagram of water
Figure 2.2 Variation of dielectric constant of water with temperature and pressure
[10]22
Figure 2.3 Teflon-Lined Stainless Steel Autoclave
Figure 2.4 Flow chart of Hydrothermal Synthesis
Figure 3.2.1 Photograph of XRD instrument at UGC-CSR, Indore Centre40
Figure 3.2.2 Photograph of XRD instrument at ERDA, Vadodara41
Figure 3.3.1 Xrd reflections of undoped and Cerium doped PbWO ₄ synthesized using
Lead acetate (1, 2) and Lead nitrate (3, 4)47
Figure 3.3.2 Xrd reflections of undoped and Cerium doped PbWO ₄ synthesized
using Lead chloride (5,6)47
Figure 3.3.3 Magnified (112) reflection peak of (a) Sample 1-4 (b) Sample 5-652
Figure 3.5.1 Indexed XRD reflections of PbWO ₄ synthesized at (a) 3pH, (b) 7pH and
(c) 11pH56
Figure 3.5.2 XRD pattern of PbWO ₄ prepared at different pH57
Figure 3.5.3 Shift of (112) reflection peak of PbWO ₄ prepared at different pH58
Figure 3.6.1 XRD pattern of PbWO ₄ prepared at different temperature
Figure 3.6.2 Effect of synthesis Temperature on Lattice Parameters of PbWO ₄ 63
Figure 3.6.3 Effect of synthesis Temperature on Volume and Average Crystallite size
of PbWO ₄ 64
Figure 3.6.4 Shift of (112) peak of PbWO ₄ synthesized at different temperature65
Figure 3.7.1 Indexed XRD spectra of PbWO ₄ : Ce synthesized at (a) R.T. (b) 100°C
(c) 150°C and (d) 200°C68
Figure 3.7.2 XRD pattern of PbWO ₄ :Ce prepared at different Temperature68
Figure 3.7.3 Effect of synthesis Temperature on Lattice Parameters of
PbWO ₄ :Ce70

.

rigure 31	.4 Effect of synthesis Temperature on Volume and Average Crystallite
	size of PbWO ₄ :Ce71
Figure 3.7	7.5 Shift of (112) peak of PbWO ₄ :Ce synthesized at different temperature72
Figure 3.8	3.1 Xrd spectra of PbWO ₄ and PbWO ₄ :Ce synthesized at 100°C74
Figure 3.8	3.2 Xrd spectra of PbWO ₄ and PbWO ₄ :Ce synthesized at 150°C75
Figure 3.8	3.3 Xrd spectra of PbWO ₄ and PbWO ₄ :Ce synthesized at 200°C75
Figure 3.8	3.4 Shift of (112) peak of undoped and Cerium doped PbWO ₄ prepared
	at different temperature
Figure 4.1	Photograph of TEM (Model : Philips Tecnai 20 G2, FEI make) instrument
	at UGC-CSR, Indore Centre
Figure 4.2	Photograph of TEM (Model : Philips Tecnai 20, Holland) instrument at
	SICART, Vidhyanagar, Anand
Figure 4.3	Photograph of SEM (JEOL JSM-6380LV) instrument at ERDA,
	Vadodara
Figure 4.4	SEM images of $PbWO_4$ (a) agglomeration of dendrite with single trunk
	reported in ref. [2]; (b) single trunk dendrite produced using Lead acetate
	as lead source; (c) tetrahedron microparticles reported in ref. [3]; (d)
	tetrahedron microparticles produced using Lead acetate as lead source
Figure 4.	SEM images of microbelts (left) and octahedron microparticles (right) of
	PbWO ₄ :Ce produced using Lead acetate as lead source90
Figure 4.0	5 TEM images of PbWO4:Ce produced using Lead acetate as lead source91
Figure 4.7	Growth mechanism of PbWO ₄ microbelt suggested by C. Zheng [7]93
Figure 4.8	(a) SEM image of agglomerated microbelts and dendrites of PbWO ₄ ;
	(b) High magnified SEM image of individual six branched/trunk dendrite
	(inset shows same dendrite with scale); (c) Three dimensional dendrite

Figure 4.9 TEM image of rhombic shaped PbWO ₄ microparticles (a) synthesized by
us without using any surfactant; (b) synthesized by using PVP [12] and (c)
CTAB [13] surfactant; (d) nanoparticles prepared without surfactant97
Figure 4.10 TEM images of Cerium doped tetrahedron PbWO ₄ prepared using Lead
nitrate as a Lead source with different magnification100
Figure 4.11 TEM images of agglomerated octahedron microparticles and flat micro
belts of PbWO ₄ prepared with Lead Chloride (both images are of same
sample)102
Figure 4.12 TEM images of agglomerated tetrahedron microparticles of Cerium
doped PbWO ₄ prepared with Lead Chloride (both images are of same
sample)103
Figure 4.13 The high-magnification TEM images of (a) quasi-spherical hollow nano
particles (HNPs) of PbWO ₄ with scale (b) hollow nano tubes (HNTs) of
PbWO ₄ with scale (c) individual single HNT109
Figure 4.14 Schematic diagram showing formation of PbWO ₄ Hollow Nano Particles
by Process A111
Figure 4.15 Polycrystalline Ag ₂ Se nanotubes [29]112
Figure 4.16 TEM image of agglomerated PbWO ₄ nanorods113
Figure 4.17 TEM images of PbWO ₄ prepared at (a-b) 100°C and (c-d) 125°C
temperatures117
Figure 4.18 TEM images of PbWO ₄ :Ce prepared at (a-b) 100°C and (c-d) 200°C
temperatures118
Figure 4.19 TEM image of $PbWO_4$ microparticle synthesized by hydrothermal
method using Tripotassium citrate surfactant at 180°C temperature by
Wei Zhao119

Figure 5.2 Schematic diagram of a crystal field splitting and hybridization WO_4^{2-}	
group [4]	
Figure 5.3(a) PL spectra of PbWO ₄ synthesized with different Lead Sources	137
Figure 5.3(b) PL spectra of PbWO ₄ synthesized with Lead Acetate	137
Figure 5.3(c) PL spectra of PbWO ₄ synthesized with Lead Nitrate	137
Figure 5.4 PL spectra of PbWO ₄ prepared with Lead Chloride at 100°C	140
Figure 5.5 Splitting of Triplet states due to Jahn-Teller effect [45]	143
Figure 5.6 Excitation spectra of PbWO ₄ (sample 8)	147
Figure 5.7 Effect of Synthesis Parameters on PhotoLuminescence intensity	149
Figure 5.8 PL spectra of PbWO ₄ synthesized at 200°C	150
Figure 5.9 PL emission of $PbWO_4$ synthesized at different pH excited with 300nm	ı154
Figure 5.10 PL emission of PbWO ₄ synthesized at different pH excited with 254 r	ım155
Figure 5.11 PL spectra of PbWO ₄ synthesized at different temperatures	159
Figure 5.12 PL spectra of PbWO ₄ prepared at different temperatures excited with	
254nm	161
Figure 5.13 PL spectra of PbWO4:Ce prepared at different temperatures excited w	vith
300nm	165
Figure 5.14 PL spectra of PbWO ₄ : Ce prepared at different temperatures excited v	vith
254nm	166
Figure 5.15 Up-conversion luminescence in PbWO ₄ synthesized at different pH	170
Figure 5.16 Up-conversion luminescence in PbWO ₄ synthesized at different	
Temperatures	