

List of figures

Figure 1.1: Diagram showing the process of luminescence

Figure 1.2: Schematic representation of Fluorescence and Phosphorescence

Figure 1.3: Configurational Coordinate Diagram

Figure 1.4: (a) Symmetrical stretching of square planar and (b) asymmetrical stretching of octahedron

Figure 1.5: Up-conversion by Ground/Excited State Absorption

Figure 1.6: Upconversion by Energy Transfer Up-conversion process

Figure 1.7: Upconversion by Photon avalanche

Figure 1.8: Ladder like arrangements of energy levels of lanthanide ions

Figure 1.9: Schematic view of LED coated with upconversion phosphor layer

Figure 1.10: Schematic view of a new system consists of a solar cell and up-converter

Figure 1.11: A schematic energy-level diagram of up-converter

Figure 1.12: Optical instrumental setup for bioimaging

Figure 1.13: Tristimulus Response Curves

Figure 1.14: CIE 1931 Chromaticity Diagram

Figure 2.1: Reflection of X-rays by two successive atomic planes

Figure 2.2: A schematic view of SEM

Figure 2.3: A simple view of essential components of Fluorescence Spectrometer

Figure 3.1: EDAX spectra of LMO 1

Figure 3.2: EDAX spectra of LMO 2

Figure 3.3: EDAX spectra of LMO 3

Figure 3.4: EDAX spectra of BO 1

Figure 3.5: EDAX spectra of BO 2

Figure 3.6: EDAX spectra of BO 3

Figure 3.7: EDAX spectra of CO 1

Figure 3.8: EDAX spectra of CO 2

Figure 3.9: EDAX spectra of CO 3

Figure 3.10: XRD pattern of $\text{La}_2(\text{MoO}_4)_3$ phosphors doped with Yb and Er for LMO 1

Figure 3.11: XRD pattern of $\text{La}_2(\text{MoO}_4)_3$ phosphors doped with Yb and Er for LMO 2

Figure 3.12: XRD pattern of $\text{La}_2(\text{MoO}_4)_3$ phosphors doped with Yb and Er for LMO 3

Figure 3.13: XRD pattern of Bi_2O_3 phosphors doped with Yb and Er (BO 1)

Figure 3.14: XRD pattern of Bi_2O_3 phosphors doped with Yb and Er (BO 2)

Figure 3.15: XRD pattern of Bi_2O_3 phosphors doped with Yb and Er (BO 3)

Figure 3.16: XRD pattern of CdO phosphors doped with Yb and Er (CO 1)

Figure 3.17: XRD pattern of CdO phosphors doped with Yb and Er (CO 2)

Figure 3.18: XRD pattern of CdO phosphors doped with Yb and Er (CO 3)

Figure 3.19 (a): SEM image of sample LMO 1 at 550 X

Figure 3.19 (b): SEM image of sample LMO 1 at 1000 X

Figure 3.19 (c): SEM image of sample LMO 1 at 2000 X

Figure 3.20 (a): SEM image of sample LMO 2 at 550 X

Figure 3.20 (b): SEM image of sample LMO 2 at 1000 X

Figure 3.20 (c): SEM image of sample LMO 2 at 2000 X

Figure 3.21 (a): SEM image of sample LMO 3 at 550 X

Figure 3.21 (b): SEM image of sample LMO 3 at 1000 X

Figure 3.21 (c): SEM image of sample LMO 3 at 2000 X

Figure 3.22 (a): SEM image of sample BO 1 at 550 X

Figure 3.22 (b): SEM image of sample BO 1 at 1000 X

Figure 3.22 (c): SEM image of sample BO 1 at 2000 X

Figure 3.23 (a): SEM image of sample BO 2 at 550 X

Figure 3.23 (b): SEM image of sample BO 2 at 1000 X

Figure 3.23 (c): SEM image of sample BO 2 at 2000 X

Figure 3.24 (a): SEM image of sample BO 3 at 550 X

Figure 3.24 (b): SEM image of sample BO 3 at 1000 X

Figure 3.24 (c): SEM image of sample BO 3 at 2000 X

Figure 3.25 (a): SEM image of sample CO 1 at 550 X

Figure 3.25 (b): SEM image of sample CO 1 at 1000 X

Figure 3.25 (c): SEM image of sample CO 1 at 2000 X

Figure 3.26 (a): SEM image of sample CO 2 at 550 X

Figure 3.26 (b): SEM image of sample CO 2 at 1000 X

Figure 3.26 (c): SEM image of sample CO 2 at 2000 X

Figure 3.27 (a): SEM image of sample CO 3 at 550 X

Figure 3.27 (b): SEM image of sample CO 3 at 1000 X

Figure 3.27 (c): SEM image of sample CO 3 at 2000 X

Figure 4.1: Distribution of energy in the solar spectrum

Figure 4.2: Absorption range in different Solar Cells

Figure 4.3: PL spectrum of sample LMO 1 $\{La_{2(0.79)}(MoO_4)_3: Yb_{(0.2)}, Er_{(0.01)}\}$

Figure 4.4: PL spectrum of sample LMO 2 $\{La_{2(0.78)}(MoO_4)_3: Yb_{(0.2)}, Er_{(0.02)}\}$

Figure 4.5: PL spectrum of sample LMO 3 $\{La_{2(0.77)}(MoO_4)_3: Yb_{(0.2)}, Er_{(0.03)}\}$

Figure 4.6: Changes in peak intensity in LMO samples

Figure 4.7a: Change in peak intensity for the transition ${}^2H_{11/2} \rightarrow {}^4I_{15/2}$ of Er^{3+} ion

Figure 4.7b: Change in peak intensity for the transition ${}^4S_{3/2} \rightarrow {}^4I_{15/2}$ of Er^{3+} ion

Figure 4.8a: Overlapping of the emission spectra of LMO 1 with the colour matching functions

Figure 4.8b: Overlapping of the emission spectra of LMO 2 with the colour matching functions

Figure 4.8c: Overlapping of the emission spectra of LMO 3 with the colour matching functions

Figure 4.9: Photograph of the emitted colour and the corresponding chromaticity diagram (LMO)

Figure 4.10: Mechanism of up conversion in $La_2(MoO_4)_3: Yb^{3+}, Er^{3+}$

Figure 4.11: PL spectrum of sample BO 1 $\{Bi_2O_3: Yb_{(0.2)}, Er_{(0.01)}\}$

Figure 4.12: PL spectrum of sample BO 2 $\{Bi_2O_3: Yb_{(0.2)}, Er_{(0.02)}\}$

Figure 4.13: PL spectrum of sample BO 3 $\{Bi_2O_3: Yb_{(0.2)}, Er_{(0.03)}\}$

Figure 4.14: Change in intensity with Er content (for BO samples)

Figure 4.15: Overlapping of the emission spectrum of $Bi_2O_3: Yb^{3+}, Er^{3+}$ with the colour matching functions.

Figure 4.16: Photograph of the emitted colour and the corresponding chromaticity diagram (BO)

Figure 4.17: Mechanism of up conversion in $Bi_2O_3: Yb^{3+}, Er^{3+}$

Figure 4.18: PL spectrum of sample CO 1 $\{CdO: Yb_{(0.2)}, Er_{(0.01)}\}$

Figure 4.19: PL spectrum of sample CO 2 $\{CdO: Yb_{(0.2)}, Er_{(0.02)}\}$

Figure 4.20: PL spectrum of sample CO 3 $\{CdO: Yb_{(0.2)}, Er_{(0.03)}\}$

Figure 4.21: Change in intensity with Er^{3+} content (for CO samples)

Figure 4.22: Overlapping of the emission spectrum of $CdO: Yb^{3+}, Er^{3+}$ with the colour matching functions.

Figure 4.23: Photograph of the emitted colour and the corresponding chromaticity diagram (CO)

Figure 4.24: Mechanism of up conversion in CdO: Yb³⁺, Er³⁺

Figure 5.1: Mechanism of DSSC

Figure 5.2: Spectral response of Ruthenium Dye

Figure 5.3: Spectral response of Anthocynin Dye

Figure 5.4: Actual view of measurement of Solar-Cell efficiency under Sunlight.

Figure 5.5: Circuit Diagram for measuring I – V Characteristics of Solar Cell.

Figure 5.6: I – V curve of cell prepared with only TiO₂ powder

Figure 5.7: I – V curve of Solar cell prepared with TiO₂ + LMO 1

Figure 5.8: I – V curve of Solar cell prepared with TiO₂ + LMO 2

Figure 5.9: I – V curve of Solar cell prepared with TiO₂ + LMO 3

Figure 5.10: I – V curve of Solar cell prepared with TiO₂ + BO 1

Figure 5.11: I – V curve of Solar cell prepared with TiO₂ + BO 2

Figure 5.12: I – V curve of Solar cell prepared with TiO₂ + BO 3

Figure 5.13: I – V curve of Solar cell prepared with TiO₂ + CO 1

Figure 5.14: I – V curve of Solar cell prepared with TiO₂ + CO 2

Figure 5.15: I – V curve of Solar cell prepared with TiO₂ + CO 3

Figure 5.16: Comparison of efficiencies