

Photoluminescence Properties of Single crystals-A very short Review

K. Gayathiridevi^{1,2} and G. Pasupathi^{1,3*}

¹Research and Development Center, Bharathidasan University, Thiruchirappalli, 620 025, India

²Department of Physics, Bharathidasan University Constituent College for Women, Orathanadu -614 625, India

^{3*}Department of Physics, A.V.V.M. Sripushpam College (Auto), Poondi -613 503, India

Abstract: Photoluminescence properties of single crystal was analysed and its applications and uses were discussed. Electroluminescence by a voltage applied to the luminescent substance. Triboluminescence by utilization of mechanical energy such as grinding. Chemiluminescence by utilization of the energy of a chemical reaction. The lowest energy MLCT transitions are tuned from 400 nm to 500 nm by tuning the energy of the HOMO levels. These complexes show emission maxima in the blue, green and yellow region of the visible spectrum and exhibit unprecedented phosphorescence quantum yields.

Keywords; PL, UV-Vis studies, Raman studies and applications

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I. INTRODUCTION

Luminescence denotes the absorption of energy in matter and its reemission as visible or near visible radiation. Sometime the terminology also varies with the exciting source. Photoluminescence depends on excitation by electromagnetic radiation (photons). Catholuminescence by energetic electrons or cathode rays.. The general phenomena of luminescence have been classified according to the duration of the emission following removal of excitation. When excitation is removed there is invariably an exponential decay of afterglow whose rate is independent of excitation intensity and of temperature. If the emission occurs during excitation or within 10⁻⁸ sec of excitation, the process is termed as fluorescence. If the emission occurs after excitation has ceased the process is called phosphorescence. Luminescence is observed with all states of matter gases, liquids and solids both inorganic and organic. The inorganic solids which luminescence by the excitation is called phosphors. Luminescence in these materials depends on impurities or defects in structure. The impurities responsible for characteristic luminescent emission are termed activators. Other imperfections that are essential to the luminescence of inorganic solids but have little influence on spectral distribution are called coactivators. Most solid materials are not luminescent at least at ordinary temperatures. Many become sites the temperature is covered. Luminescent solids are usually electrical insulators, but often show photoconductivity with some exception, where some of the semiconductors also have marked luminescence properties. Usually there have to be special sites of atomic or molecular dimensions in the solid where the absorbed energy can be emitted by optical transition of electrons rather than dissipated as increase vibrational energy of the many atoms in the substance. Such sites are known as luminescence centers. Some atoms, ions or complexes have such features when dispersed as impurities in some crystalline solids. In particular the rare earth ions show luminescence due to transitions of electrons in the 4f inner and incomplete electrons in the shell, which is well shielded, from the surroundings by the outer electrons. In the case of transition elements of the first series [1].

II. GENERAL MECHANISM OF THE LUMINESCENCE

Assume that there is an impurity level (in the forbidden band) due to a luminescent center. Transition shows the creation of a free electron and hole due to the absorption of light of appropriate energy. An effective activator level (impurity) is one, which the electron finds, it easy to enter and leave. Otherwise the electron may prefer to recombine directly, by descending to the valence band. There are two possibilities of recombination. In one, the electron discards to an emitted activator level, and radiates by a transition to the activator ground state. This leads to fluorescence. This process is infrequent at all except high free carrier transitions. Just as the spectroscopy of atoms provided basic information on atomic structure, the luminescence of solids provides information about imperfections. In many cases the

spectra of impurities provide, through the application of crystal field theory, information on the symmetry and strength of the crystal field at the impurity site [2] shown in Figure 1.

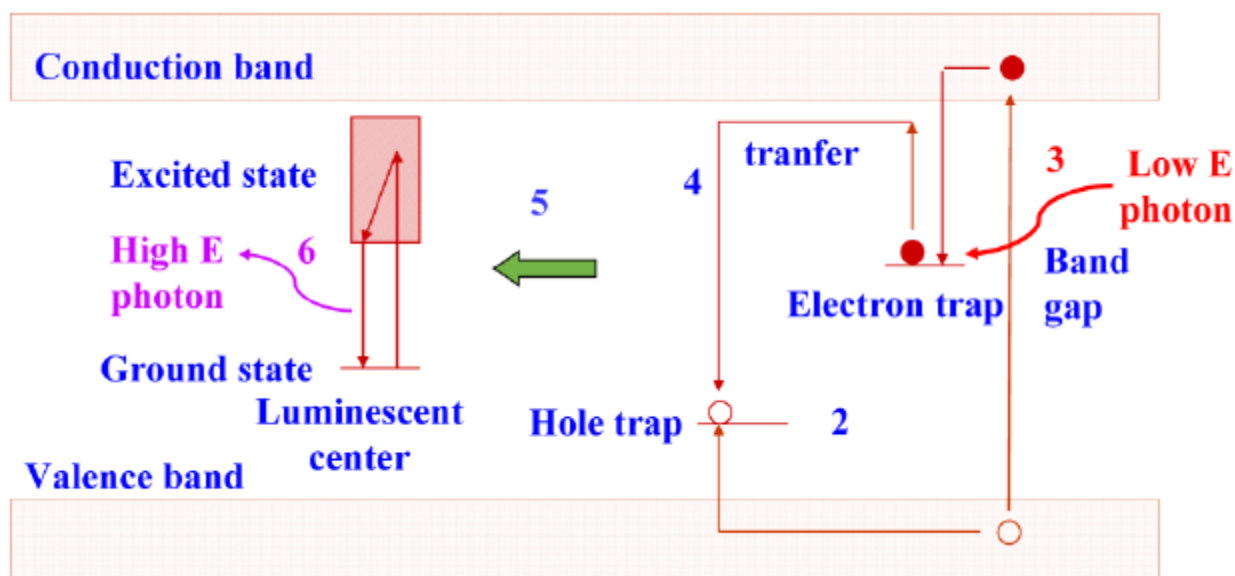


Figure1. General Mecahnism of Luminescence

III. USES OF VARIOUS LUMINESCENT PHOSPHORS

Phosphors are used in a wide variety of applications. Colour and black and white television (cathode ray excitation); the viewing screens in fluorescence (x-ray excitation); the coating of a fluorescent lamps (short wave UV excitation); high pressure colour corrected mercury lamps and fluorescent high ways signs (long UV excitation); 'safety' or 'nitelites' (electric field excitation); and 'solid state' lamps, i.e., luminescent diodes 'excited' by the injection of suitable electronic charge carriers from a battery or other power supply.

There are two types of phosphors. a) Self activated b) Impurity activated. Self-activated phosphors consists of two and sometimes three components i) the host which is the major components, ii) one or more activators (acceptors) iii) a co-activator or charge compensator (donor). Especially if the valency of the activator deviates from the valency of the host ion it replaces in the crystal lattice. The luminescent center (activator) in these phosphors appears to be a specific atomic group or individual atoms. Many of the transition elements such as Cu, Ag, Mn and Eu^{2+} can act as activators in the case of photoconductive. Phosphors and Ti, Pb, Sb, Mn and the trivalent rare earths are used as activators in the non-photoconductive phosphors. Several paramagnetic transition elements such as Fe, Co and Ni act as 'killers' decreasing the fluorescence and/or phosphorescence at very low concentration Ca 1-10 ppm. Some phosphors are very efficient emitter under one emitting wavelength but may not be under another wavelength. By introducing a sensitizing activator which is emitted efficiently [3].

Since photoluminescence of phosphors is a vast field, as halophosphate phosphor has got commercial importance for the production of fluorescence lamp phosphor, the study of the photoluminescence and preparation of the phosphor would be helpful for tube light industries.

IV. APPLICATIONS OF PHOSPHORS

4.1 Lamp Phosphors

We come now to a significant new development in fluorescent lamp technology, as pioneered by Philips. The marketability of fluorescent lamps hinges on optimally satisfying three requirements, often mutually exclusive, (i.e) brightness, colour rendering, and cost. We have already mentioned that since its inception the fluorescent lamp has been faced with the task of emulating the colour-rendering properties of a black body radiator. Hence the use of broadband emitting phosphors, whose combined emission bands were tailored to approximate the continuum spectral distribution from a black body radiator.

In an effort to increase the lumen output of deluxe lamps, Philips experimented with a tri-component blend of line-emitting phosphors; in this context, line emission automatically means rare-earth activators. The blend components were (a) blue-emitting (b) green-emitting and red-emitting. The resulting tricolour or triphosphor lamp proved in essence that in order to have good colour rendering, it is not necessary to sacrifice brightness, as was done in the past, but that high brightness and high colour rendering can be achieved at the same time.

4.2 Phosphors for CRT Displays

The great surge in phosphor R&D that is contributed to the technical perfecting of monochrome and colour TV appears to be over, at least in the United States. In phosphors for CRT displays, the interest at present is in specialized displays operating at very high levels of luminosity and ipso facto, requiring materials that will successfully withstand the energetic pounding and temperature increase caused by electron beams of very high current density. Here the trend is away from the sulfide-based materials to more rugged hosts, and to activators exhibiting linearly in response, namely to rare-earth activated [4]

4.3 YAG and refractory oxides.

Another concern in CRT phosphors is that of minimizing the physiological discomfort of prolonged reading of computer TV terminals. A bright monochrome or coloured display becomes objectionable if the phosphors decays at too fast a rate or if the components of a multiphosphor display decay at different rates and produce a flickering light field.

4.4 X-ray Phosphors

In radiological applications, rare-earth activated phosphors produce more efficient x-ray intensifier screens than conventional tungstate phosphors, and can therefore reduce radiation dosage. The anticipated switch to these new, more efficient materials has not occurred yet, partly because the new phosphors have to replace a well established, traditional technology in the conservative medical field. Large area transparent ceramics activated with rare earth ions have been proposed as energy selective detectors of x-ray radiation in CRT scanners.

4.5 Electroluminescent Phosphors

There has been a recent resurgence of interest in large area, thin film displays for computer terminals and other applications, including automotive displays. The problem area in these applications tends to be dielectric breakdown in the thin film layers, rather than the actual generation of light by the phosphor.

4.6 Photosensitive Detectors

A detector of radiant energy should have a linear response in the spectral region used and sensitivity sufficient for the particular task at hand. A barrier-layer photo cell is the simplest and requires little additional equipment, but its response is difficult to amplify. Its use is restricted generally to instruments with an optical system that permits a wide band of radiant energy to strike the detector. Instruments that restrict the bandwidth of the radiant energy reaching the detectors will need to employ photo tubes provides the maximum signal and permits use of extremely narrow slits.

4.7 Review of Single crystals based on Photoluminescence Studies

Review of the substantial effort that has been made to measure and understand the effects of corrosion with respect to the properties, performance, and durability of various forms of silicon carbide and silicon nitride. The environments include dry and moist oxygen, mixtures of hot gaseous vapors, molten salts, molten metals, and complex environments pertaining to coal ashes and slags [8].

Single crystals of a new nonlinear optical material, cadmium zinc thiourea acetate (CZTA), were successfully grown by slow evaporation of the aqueous solution at room temperature. The optical transmission studies and second harmonic generation (SHG) efficiency studies justified the device quality of the grown crystals [9].

Ni nanowire arrays of high aspect ratio with the diameters of about 30 nm and 60 nm were prepared by DC applied AC electrodeposition. Shi J.B et al observed that different preferred orientation and various magnetic behaviors of 30 and 60 nm diameter nanowires. In addition, the coercivity $H_c(\parallel)$, squareness $S(\parallel)$ and the ratio $H_c(\parallel)/H_c(\perp)$ where the applied field is parallel (\parallel) and perpendicular (\perp) to the long axis of nanowires increase with decreasing wire diameter. This is the first time that optical results of Ni nanowires were presented [10]

PbS/polypyrrole core-shell nanocomposites were successfully synthesized via in situ chemical oxidation polymerization of pyrrole based on the octahedral PbS nanocrystals colloid. A possible formation mechanism of the PbS/polypyrrole core-shell nanocomposites was also proposed [11]

To fully characterize the structure of these alloys it is necessary to augment crystallography with local structural measurements. Tellurium dioxide is doped with Zinc acetate dihydrate with Glycine to synthesis the powdered particles of ZnTe by simple chemical synthesis, Zinc acetate dihydrate is taking as the ratio of 90% and Tellurium dioxide as 10% this synthesized powdered particles were pelletized to

evaporate on the glass plate by using Electron beam evaporation technique. It has been observed that the energy in MeV of the element is well in agreement with Zinc and Telluride which is present in the preparation [12]

V. CONCLUSION

Regardless of the ionic or the covalent character of the binding crystal, the transition responsible for emission in these materials involves states with the 3d5 electronic configuration. The ground state is the 6S state; the excited state may be approximated by 4G state, although coupling of the angular momentum of the free ion with the crystal field reduces the significance of the angular momentum quantum number of the free ion. This review suggests that optical properties of single crystals are based on sulphide and nitride group of crystals. Particularly these materials can be used for the applications of photoluminescence properties

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