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LUMINEISCENCE – THE VALUBLE MATERIAL

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ABSTRACT: *There are unprecedented opportunities today for new materials and for the novel processing of existing materials. Material science is a key of technology, to make it possible to design and researcher makes a material for a scientific need. The ideas and opportunities for new materials have never been greater. The reason for which is a combination of science and engineering push and market pull. Science and engineering have taken materials from the apparent plateau of the fifties and sixties of well-defined classes of homogenous materials developed principally for their mechanical properties, into the exciting world of composites, laminates and surface coating and into the miniature world of microprocessors, memories, super-conducting filaments and nano-technology. The area of application of materials is vast and varied, so is the need for material development suited for that application.*

Keywords: *Luminescence, fluorescence, phosphorescence*

I. INTRODUCTION

Luminescence is defined as the emission of light by bodies which is in excess of that attributable to black body radiation; and persists considerably longer than the periods of electromagnetic radiations in the visible range after the excitation stops.

Luminescence is traditionally classified as fluorescence and phosphorescence. Historically, the luminescence characterized by temperature independent decay was called as fluorescence while that exhibiting the temperature dependent decay, the phosphorescence. However, according to modern conventions fluorescence refers to emission of relatively short persistence (10^{-6} -10^{-12} seconds), whereas the phosphorescence persists considerably longer (sometimes even for seconds). The line of demarcation is rather arbitrary.

II. CLASSIFICATION BASED ON CHEMICAL FORMULA

A further classification of the phenomenon is made on the basis of source of excitation. A prefix is added to indicate the source of excitation. Thus, photo-luminescence refers to the luminescence excited by photons, chemi-luminescence to that excited by chemical reaction, radio-luminescence to that excited by ionizing radiations, etc. Thermoluminescence, however, is an exception to this nomenclature-rather it is a misnomer. Thermoluminescence is the thermal stimulation of luminescence excited by other means, and thermal energy is not the source of excitation.

There is a general composition ratio between metal oxide (MeO) [Me = Ca, Ba, Sr] and aluminium oxide (Al_2O_3) for different chemical formula of the aluminates which is described here as :

Ortho-aluminate $MeO:Al_2O_3$ =1:1 = $MeAl_2O_4$ [e.g. $SrAl_2O_4$,$YAlO_3$ etc.]

Di-aluminate $MeO:2Al_2O_3$ =1:2 = $MeAl_4O_7$ [e.g. $SrAl_4O_7$,$CaAl_4O_7$ etc.]

Hexa-aluminate $MeO:6Al_2O_3$ =1:6 = $MeAl_{12}O_{19}$ [e.g.$CaAl_{12}O_{19}$,$SrAl_{12}O_{19}$ etc.]

III. APPLICATIONS

Recently, there has been a lot of interest in aluminates due to their potential as materials with useful optical properties. Various compounds of aluminates has found many applications in different fields i.e. lamp phosphors, solid state laser materials, up-conversion phosphors, luminescent paints and inks, PDPs, scintillation, TL-dosimeter, LLP, pigments, non-linear optical materials etc.

The luminescent materials find applications in many fields. They are used in X-ray screens, X-ray scintillators, PSL X-ray imaging, TLD solid state lasers, upconversion, lamp phosphors, RPL phosphors, Paints and inks, TV screens, CR tubes, LED etc. materials.

There has been a lot of interest in aluminates due to their potential as materials with useful optical properties. The new aluminates, e.g. $SrAl_{12}O_{19}$, $SrAl_2O_4$, in the form of Eu^{2+}-doped oxide matrices, have been recently investigated as candidates for luminescence.

Aluminates have been the object of attention mainly because of their applications in the field of luminescence. The alternative structures are formed ,as spinels, β-alumina , magnetoplumbite , distorted-magnetoplumbite etc. with different classes of aluminates (ortho-aluminate, di-aluminate , hexa-aluminate etc.). Hexa-aluminates is the object of deep investigation in the present work because of its use as a luminescent material.

IV. SCOPE

The search for new materials with desirable optical properties has become important in recent years. In particular, a need has emerged for compounds that are candidates for luminescence study. Considerable improvement in the field of luminescent materials has been made by the introduction of rare earth ions as activators. Rare earth ions possess unique optical behavior when doped into materials and have paved the way for the development of optical amplifiers and phosphors.

Many rare earth activated alkaline aluminates and their related compounds are of interest due to their unusual stability and useful luminescent properties. They are used for different applications such as phosphors for lamps, colour TV screens, long lasting devices, laser host, scintillators and pigments.These phosphors are synthesized using low cost and time saving synthesis method i.e. combustion synthesis. This procedure is attractive because of its capacity to yield products at 500°C which otherwise are prepared at temperatures as high as 1500°C. The process is based on mixing stoichiometric proportion of component nitrates and a suitable fuel. The heat of exothermic reaction between the redox mixture elevates temperature of constituents to around 1500°C, the components are transformed into products.

V. CONCLUSION

One of the objectives of this study is to understand in a better way the mechanism of luminescence and energy transfer in aluminate compounds such as hexa-aluminates as well as other aluminate compounds. These materials along with other materials such as compounds of aluminates single doped or co-doped were studied for their use in the field of TL dosimetry and long lasting phosphorescence.

Simple synthesis of known aluminate phosphors, which are used as lamp phosphors, and long lasting phosphors, using easily available starting materials were also investigated. The studies have been completed to the extent possible within the available time. Possible future developments are pointed out.

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